A SIXTEEN-THOUSAND HORSE-POWER MOTOR-LINER

NEW YORK SEATTLE

MOTORSHIP

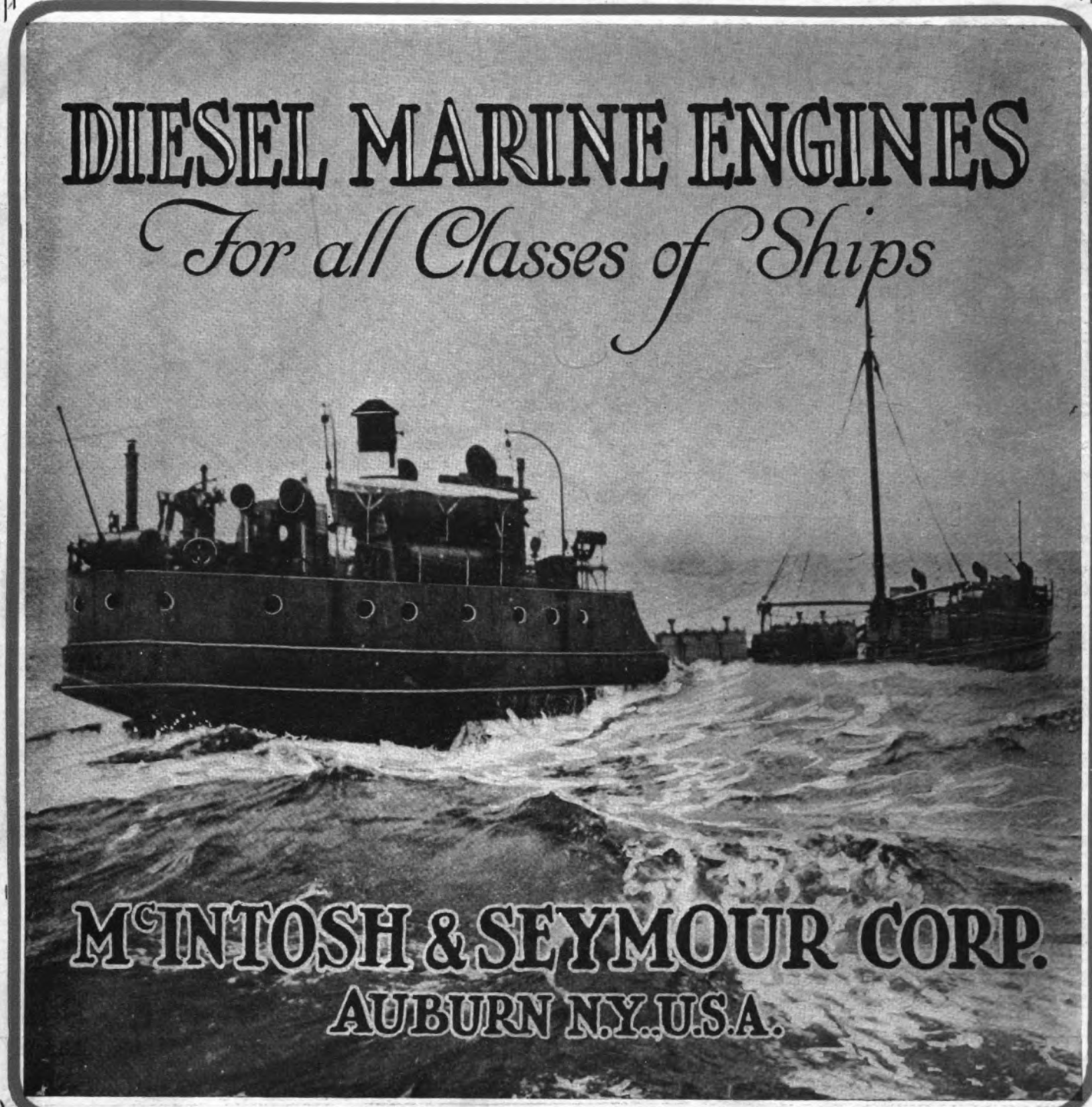
Devoted to Commercial and Naval Motor Vessels

"MOTORSHIP" is entered as second-class matter at the Post-office at New York, N. Y., U. S. A., July, 1918, under the Act of March 3rd, 1879.
Office of Publication, 1270 Broadway, New York, N. Y.

Issued Monthly
PRICE 25 CENTS
Domestic, $3.00 per year
Foreign, $3.50 per year

DECEMBER, 1920
Vol. 5 No. 12

DIESEL MARINE ENGINES
For all Classes of Ships



McINTOSH & SEYMOUR CORP.
AUBURN N.Y.U.S.A.

Generated on 2024-09-13 14:37 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

EXCLUSIVE motorship-operating and technical articles by the world's foremost writers on marine engineering appear in every issue.

MOTORSHIP

(Trade Mark Registered)

PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship construction.

Vol. V | New York, U. S. A., December, 1920 | No. 12

A Six-Hundred Foot Motor-Liner

New 16,000 Ind. Horse-power Diesel-Driven Ship Announced by Mr. Dan Brostrom, the Well-Known Swedish Shipping Magnate

(EXCLUSIVE TO "MOTORSHIP")

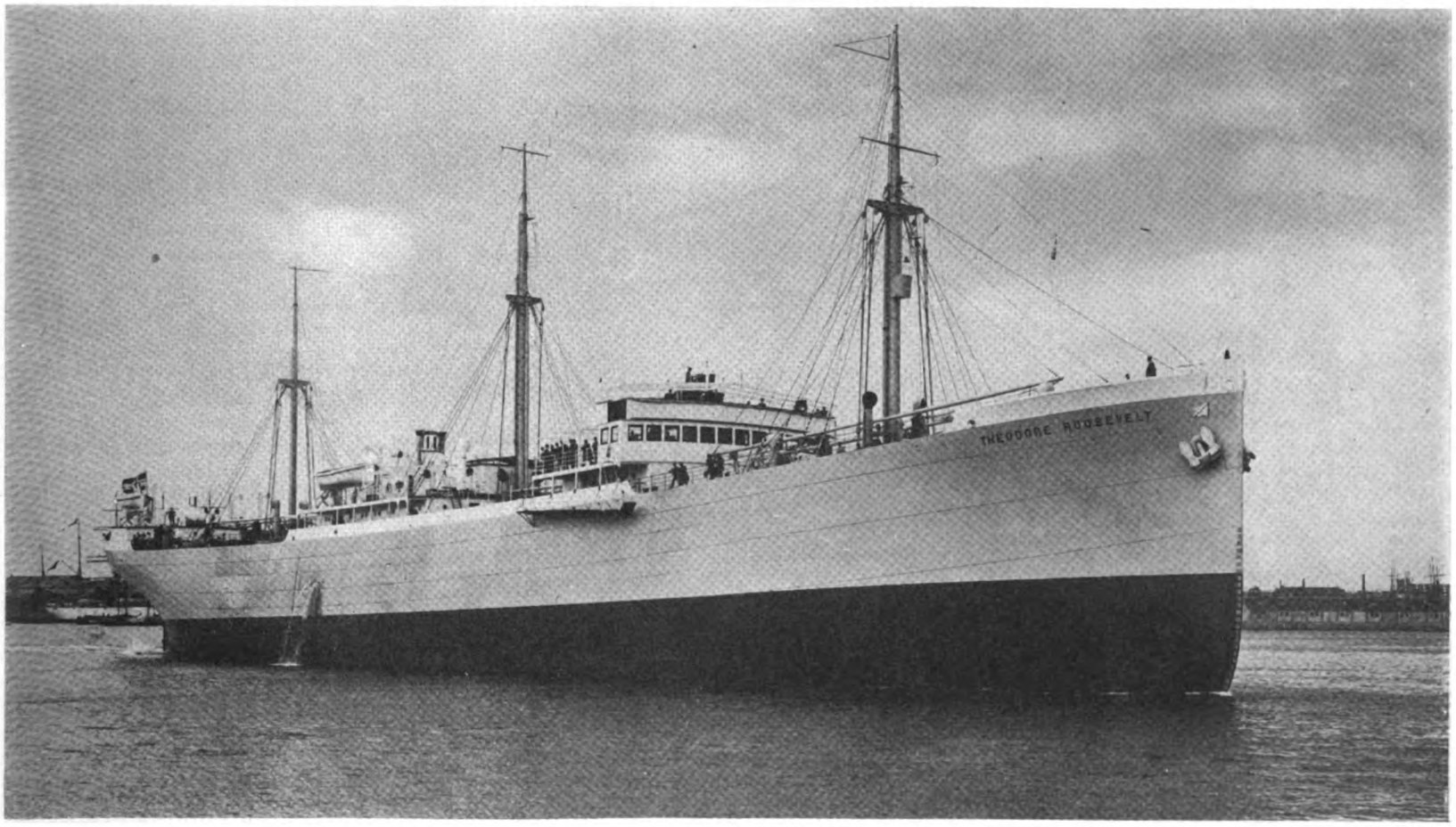
"NOW in the preliminary stages of design is a 600 ft. fast transatlantic Diesel motor-liner for the Swedish American Line"—said Mr. Dan Brostrom to the Editor of "Motorship" on board the S. S. Stockholm just prior to the sailing of that vessel from New York. "This great motorship is the largest yet seriously planned by any ship owning company in the World, continued Mr. Brostrom, and will be propelled by four-cycle Diesel oil-engines aggregating 16,000 i.h.p. Her dimensions will be 590 ft. length b.p., by 72 ft. breadth and a little over 600 ft. long overall. Plans are now being drawn-up for the company by Burmeister & Wain, the Danish motor shipbuilders at Copenhagen, but the vessel will be built at the Gotaverken, of Goteborg, Sweden, who are licensees of the Danish firm.

"The present intention is to install four Burmeister & Wain four-cycle type Diesel engines, each developing 4,000 i.h.p. from six-cylinders, driving twin-screws, each pair of engines being coupled in tandem." This means a cylinder output of 660 i.h.p., or within the power of many other types of Diesel engines now building in Europe for merchant-ships and only slightly higher than the cylinder-power of the Bethlehem-West Diesel engines of the "Cubore." Therefore, while the vessel herself will be a most remarkable and noteworthy ship, creating a new era in passenger service on the Atlantic, there is nothing about the machinery that calls for apprehension as to construction, operation, or reliability, except that we are inclined to think that it may be difficult to avoid crank-shaft torsional vibrations thro coupling the engines in tandem.

For this reason quadruple screws may produce better results, and propeller efficiency probably could be secured by having the two central engines of about 1,000 b.p. higher in power and slower in speed than the outer engines; say of 4,500 i.h.p. each, and the outer engines both of 3,500 i.h.p. This, of course, is merely a suggestion, and is a matter that the designers and owners will have to figure for themselves.

"Furthermore," remarked Mr. Brostrom, "we are having plans prepared for a similar ship to have Diesel-electric propulsion and another to have geared-turbine oil-fired drive. Each ship will be designed to carry a certain number of first-class passengers and their details will be worked-out to see which class of machinery will allow of the largest number of third-class passengers to be carried, in addition to estimating the operating charges."

It will be obvious that enormous economies will be effected particularly in fuel-bill, and of course, the absence of boilers and reduced quantity of fuel to be carried will increase the third-passenger accomodation very considerably and so give the vessel large passenger receipts. The fuel-consumption of the main-engines of the direct-drive Diesel ship will be about 51 tons per 24 hour day, and the auxiliary machinery will consume about 4 tons per day additional when at sea. With oil-fuel at $30.00 per ton the daily fuel-bill will be only about



New 15,095 tons loaded-displacement Norwegian motorship "Theodore Roosevelt" of the Fred Olsen Line. She was described on page 985 of our November issue. Her cargo-capacity is 567,000 cubic ft. Loaded speed 11 knots. Power 3,100 i.h.p. She was built and engined by Burmeister & Wain of Copenhagen.

Generated on 2024-09-13 14:48 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

$1,650.00, while we estimate the speed will be 18 to 19 knots.

Other motorships now on order for Swedish shipping companies controlled by Mr. Brostrom are as follows:

Owners	Tonnage (D.W.C.)	Hull Builders	Engine Builders	Horse Power (Indicated)
Swedish East Asiatic Co.....	9,500	Burmeister & Wain (Copenhagen)	Burmeister & Wain (Copenhagen)	3,100
Swedish Orient Line	4,400	Landskrona S. B. Co. (Landskrona)	Gotaverken (Göteberg)	1,600
Swedish East Asiatic Co.....10,000		Oresundsvarvet (Landskrona)	Gotaverken (Göteberg)	4,000
Swedish-American-Mexico Line	7,000	Kockums S. B. Co. (Malmo)	Burmeister & Wain (Copenhagen)	2,100
	30,900			10,800

The 9,500 tons d.w.c. motorship for the Swedish East Asiatic Line has been named "Formonia" and will run on the Sweden-China-Japan route. This company has a friendly association with the well-known Danish-East Asiatic Co., who already own a large fleet of motorships, having accepted delivery of their first Diesel-driven vessels in 1912, three having been built that year.

New Type of Motorship

Remarkable Salvage Vessel Built in Sweden

Last June we referred to an order having been placed for a powerful Diesel-driven salvage-ship with the Götaverken of Göteborg by the Göteborgs Bogserings A/B (Gothenburg Towing & Salvage Co.) This novel vessel was recently launched, and named "Fritiof" after one of the most celebrated Viking heroes in the old Swedish sagas.

In deciding upon Diesel propelling engines, and Diesel-electric and electric-pneumatic auxiliary and salvage machinery, the owners took a bold step as the "Fritiof" is equal to and probably superior in size and power to all existing steam-driven salvage-ships. But the owners and builders are confident of success, indicating the warm regard for the reliability and economy of Diesel power in Scandinavia. Furthermore, it may prove another step in demonstrating that the internal-combustion oil-engine is superior to steam for nearly every class of sea-going and inland merchant vessel. Her success or failure will have a certain bearing on this question. It also can be remembered that for a long period the Diesel engine has been used for two submarine mother and repair ships, and in one case with notable success, and in the other reasonably good results.

One valuable advantage of Diesel power for a salvage vessel is that in all cases of emergency she is ready for instant start, with a minimum of stand-by charges, instead of having to keep steam-up with its continuous consumption of coal or oil-fuel. In addition, the cruising radius of the ship is three to five times as large, allowing her to remain operating at the scene of a wreck for a much longer period without re-fueling.

The general dimensions of the "Fritiof" are as follows:

Length (over-all)	170 ft.
Length (bet. p.p.)	156 ft. 11 5/16 in.
Breadth (moulded)	34 ft., 9 5/16 in.
Depth (moulded)	18 ft., 7⅝ in.
Draft with 250 tons fuel and Cargo	13 ft., 5 in.
Power of Main Engines	1,250 i.h.p.

She is a twin-screw ship, propelled by two four-cycle Burmeister & Wain type Götaverken-built Diesel engines, each with an output of 625 i.h.p. from six cylinders 15.748 in. bore by 29.527 in. stroke at 150 R.P.M.

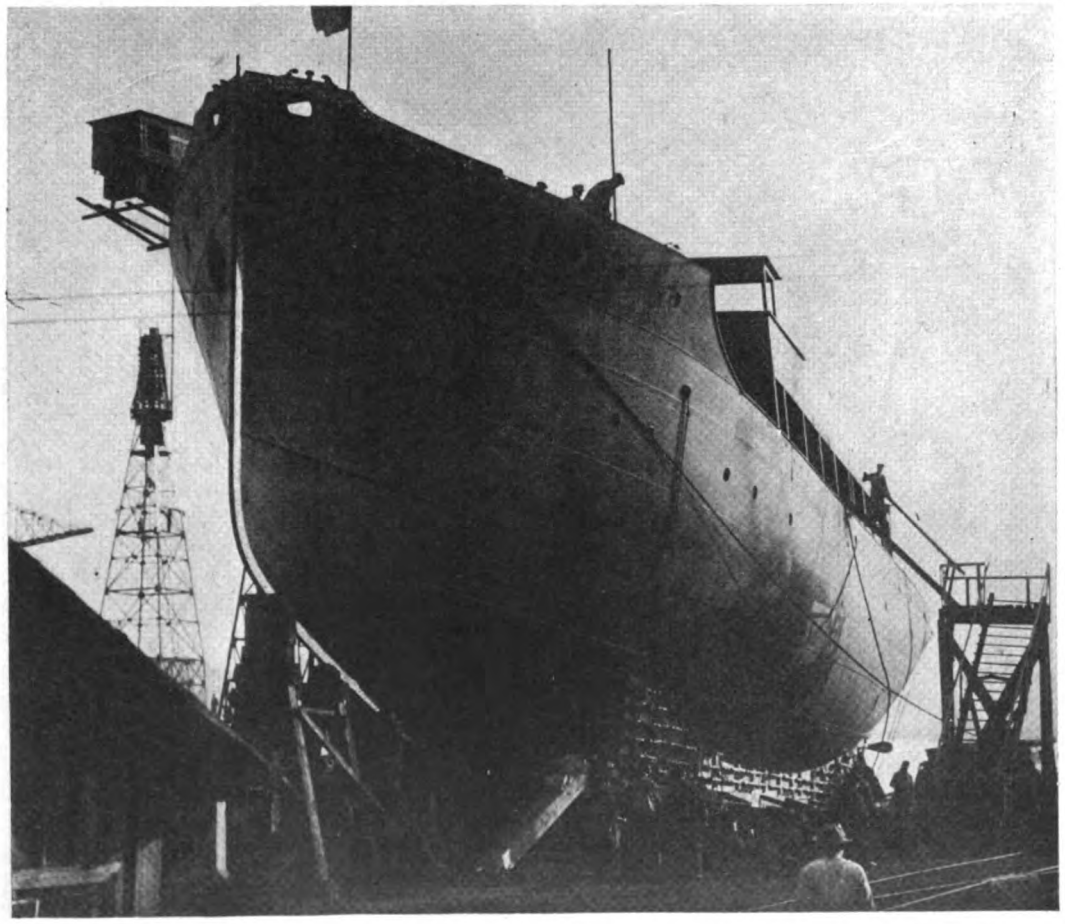
In addition there are three 90 i.h.p. Diesel engines coupled to electric-generators, which furnish current to the following electric-motor driven equipment:

2—16 in. Salvage pumps in Engine-room.
3—8 in. Portable Salvage pumps.
2—Portable Plunger pumps.

The windlass, steering-gear, two 5-ton winches and one 10 in. towing-winch are steam-driven and the rigging is designed for 10 tons lift. There also are three 8 in. motor driven portable salvage-pumps, and one 12 in. steam-driven salvage-pump; the total capacity of all the pumps being 6000 tons per hour.

The general arrangement of the machinery and accommodation can be seen on the plan; captain, spare-room, messrooms, galley and bath being located in a deckhouse amidships, the officers and crew under deck for'd, and the divers and spare accomodation under the deck aft. There are good clear deckspaces for working the salving outfit, and a hold aft for portable-boiler and workshop, also a roomy hold forward the stores.

The Gothenburg Towing & Salvage Co. has a fleet of 25 tugs and steamers up to 700 i.h.p., also lighters and pontoons for salvage work. With the new Diesel boat in commission the company will be fully able to meet all demands in the way of salvage work on the coasts of Scandinavia, as well as further away.



The powerful salvage motorship "Fritiof" on the ways at the Götaverken. She is the first of her type ever built.

AMERICAN PETROLEUM INSTITUTE

A very successful annual meeting of the American Petroleum Institute was held November 17th to 19th inclusive at Washington. Many important men of the oil industry read papers on various subjects relating to oil, including Mr. W. C. Teagle, George Otis Smith, Richard Airey, Edward L. Doheny, Thomas A. O'Donnell (President of the Institute), Henry L. Doherty, W. H. Reed and Admiral W. S. Benson.

GROWTH OF MOTOR-SHIPPING

Out of every hundred merchant-vessels in the latest issue of Lloyds Register, almost 2 are oil-engined motorships—1.7 to be exact. And,—the Register lists a total of 9,587 vessels aggregating 25,000,000 gross tons (approximately 39,000,000 tons d.w.c.). But Lloyds do not list all the Diesel-driven motorships in service!

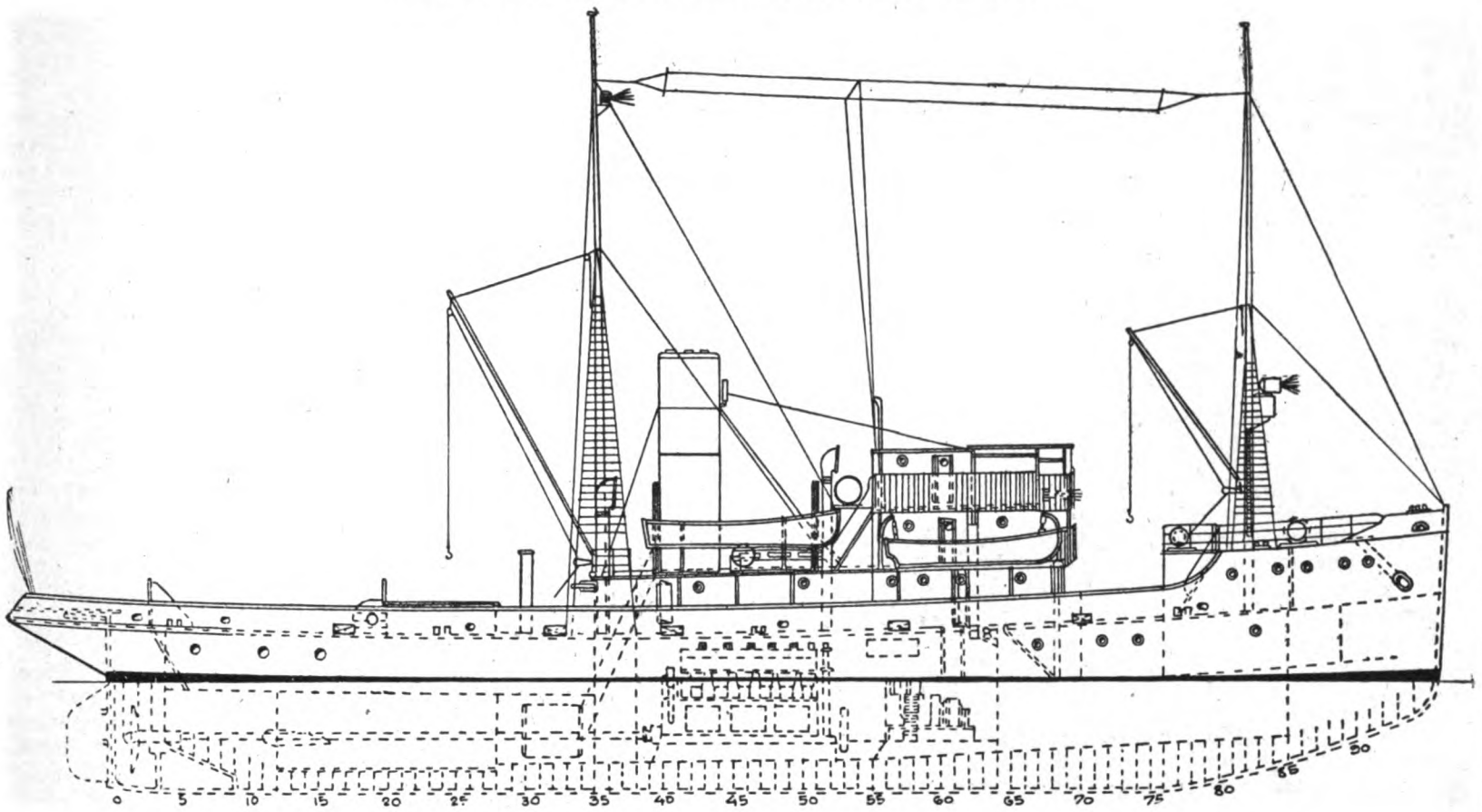
ANCHOR BROCKLEBANK LINE ORDER THIRD MOTORSHIP

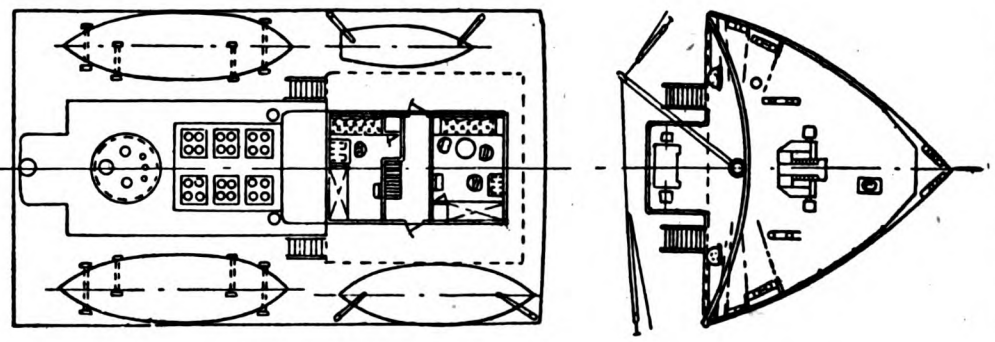
An order for a steel motorship of 4,000 tons d.w.c. has recently been placed by Thos. & Jas. Brocklebank, Ltd., of Liverpool, England, making the third Diesel-driven merchant vessel ordered from Cammell-Laird & Co. of Birkenhead.

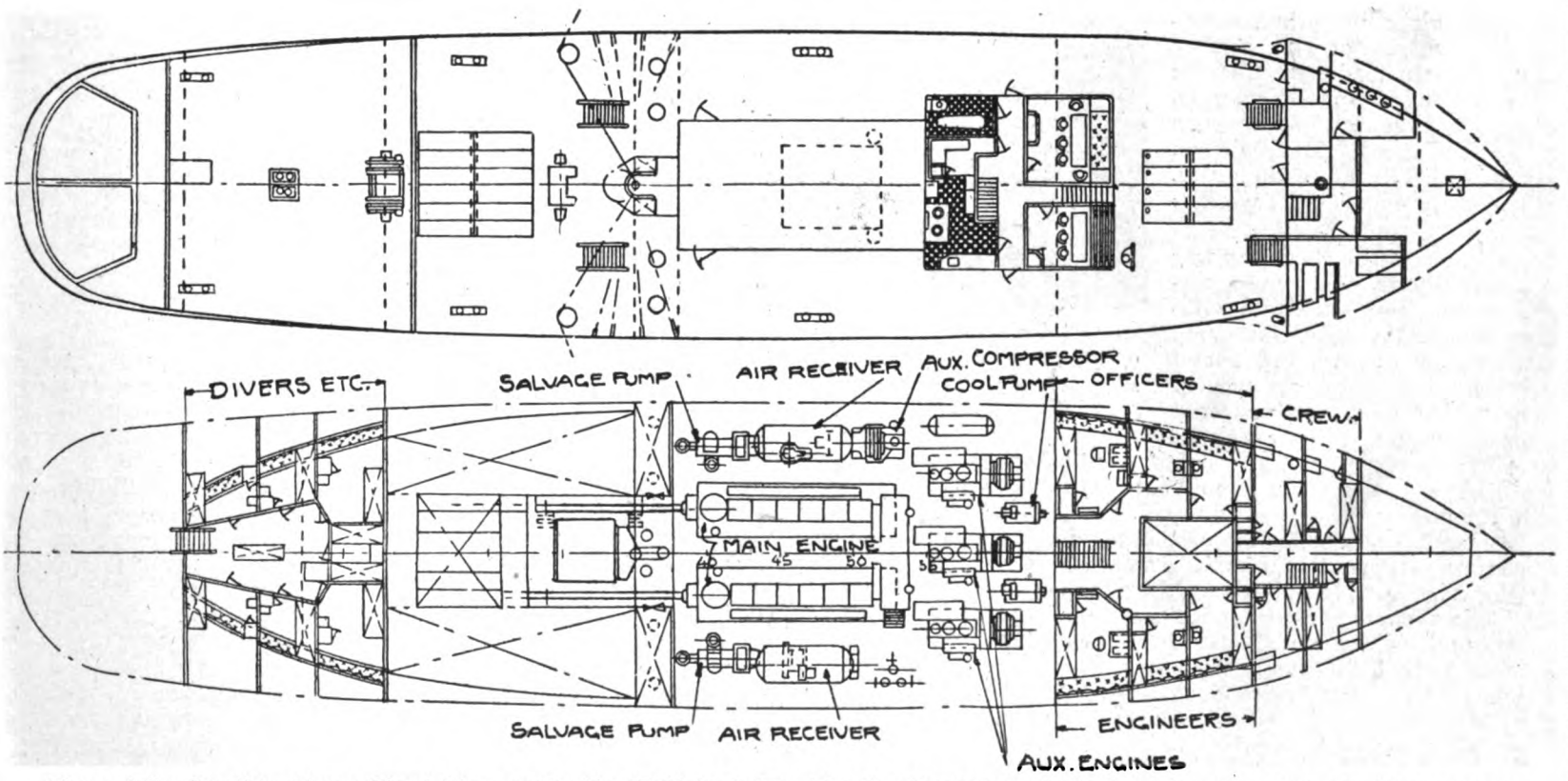
The new motorship will be equipped with twin 500 shaft h.p. Cammellaird-Fullagar opposed-piston, two-cycle type Diesel oil-engines. One of these engines will be new, but the other will be taken from the little welded-steel coastwise-boat "Fullagar," as it has been found to be too powerful for such a small craft. In the "Fullagar," machinery of less power will be installed, which will meet all the requirements of coastwise work. With the present engine this little ship has already done nearly 10,000 nautical-miles with practically no trouble, but developing more power than anticipated.

Generated on 2024-09-13 14:43 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

A NOTEWORTHY SALVAGE SHIP







Plans of the Swedish salvage Diesel-driven motorship "Fritiof" designed by the Götaverken of Göteborg, Sweden. Note the high-powered Diesel-electric auxiliaries and salvage machinery. She is propelled by two 625 i.h.p. four-cycle type Burmeister & Wain Diesel engines built by the Götaverken.

Generated on 2024-09-13 14:45 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Aspects of American Shipping From the Harriman Outlook

The Shipbuilding and Operating Facilities of This Great Organization and Its Present and Future Activities

AN INTERVIEW WITH MR. WM. AVERELL HARRIMAN
BY THE EDITOR OF "MOTORSHIP"

TO-DAY, one of the foremost men in American merchant-shipping is Wm. Averell Harriman, son of the late E. H. Harriman, the "Railroad King," and who bids fair to soon become as great a figure—if not greater—in the mercantile-marine as his father was in railroad building and financing. Mr. Harriman, tho quite a young man is head of a great ship operating-and-building organization that will form a strong backbone to our ocean-commerce, for it is on such powerful combinations that the success of our maritime commerce depends—not to Government operation of ships.

Realizing the importance of securing and making public the opinion and attitude of such a leading figure in the shipping world on the present motorship situation and its future part in keeping our merchant-marine on the Seven Seas, we sought Mr. Harriman's views and were fortunate in securing an interview. He kindly went a step further and also dealt at length with three phases of the shipping industry; namely,

(1) The oil-engined motorship; its place in the present and future of the American Merchant Marine.

(2) General shipbuilding problems.

(3) The Agreement with the Hamburg-American Line.

From Mr. Harriman's statements it will be apparent that the oil-engined motorship and its inherent economy has been given the deepest consideration by himself and his vast organization, and that he is enabled to back his belief in the advantages of this type of ship for our commerce by being in possession of ample facilities and valuable experiences for both production and operation. Shipowners and shipbuilders will note that in addition to recommending that other Americans construct motorships if they desire to attain leadership for the U. S. merchant-marine, he suggests that his own organization may soon have an adequate Diesel-driven fleet, of which two are on order. We herewith quote his remarks:

* * *

"Conditions of the European war made it vitally necessary for America to produce ships at a rate without precedent," said Mr. Harriman. "the demand was for ships and more ships, and the manner in which that demand was answered is now a matter of history. Speed was of course the great requisite, and much had to be sacrificed to that end. You will agree with me that there was little time for experiments or for the promoting of engineering progress in the marine field, so only the tried and tested were utilized or available in adequate quantities for the great program undertaken, and thousands of men had to be trained to construct these. But, the scope and variety of experience acquired under emergency conditions demonstrated the necessity for and the development of marine-engineering if economy was to be effected. The cessation of War conditions under which the concentration of marine facilities was a vital necessity required the prompt redistribution of shipping so that requirements of trade under peace conditions though still abnormal might again be met. Competitive conditions, decreasing freight rates, and the attendant necessity for economy have provided an opportunity for and encouraged, and have fostered a more intensive development of marine engineering in all its phases.

"For some time I have been deeply impressed with the oil-engined motorship and the part it is destined to take in the merchant-marine field. The progress that has been attained, and the performances already achieved in this direction furnish strong arguments for the increasing use of the oil-engine propulsion and make it apparent that American shipowners must devote attention to the Diesel-type of machinery if they expect to attain or hold the leadership for the American Merchant Marine, to which it is entitled by our participation in World trade.

"I do not necessarily, advocate adoption of the motorship in all trade routes—because the size of vessels, their speed, availability of fuel, routing and many other details must be taken into consideration. But, it is my conviction that the freight-carrying motorship in the majority of cases, if oil-fuel is available, has an advantage over the steam-propelled cargo vessel, because of its greater economy.

"It is a source of gratification to me," continued Mr. Harriman, "that one of the companies with which I am connected, the American-Hawaiian Steamship Company, for which the United American Lines, Inc., is operator, has the distinction of having been the first prominent shipping company to contract for large Diesel-driven motorships to be operated under the American flag. The two vessels now building at the Merchants Shipbuilding Corporation Yard will form the nucleum of what I hope will become a very extensive motor fleet under the house-flag of the United American Lines, which organization will cover many shipping routes where the oil-engined vessel will be the only type whose economy of operation will enable us to meet the active foreign competition we will have to face.

"A great deal of experience with oil-engined motorships had been acquired by the Hamburg-American Line before the War. I understand that this company had ordered motor vessels of several different types and for various trades in which they were trying out all the basic designs of Diesel-type engines. The four-cycle, the straight two-cycle, the double-acting and the opposed-piston types have all received their attention. Although the German Company was prevented by the War from bringing all these practical tests to a conclusion, it nevertheless gained I believe a wider and more exact knowledge of the various types than any other company possesses even at this day. It is to be expected, therefore, that American shipping through our association with the Hamburg-American Line will benefit from these experiences. Lately the Hamburg-American Co., in conjunction with the A. E. G. of Berlin, formed a large company for the building of motorships under Burmeister & Wain Diesel license in Germany. The same type of motorship is also being developed under license by an American shipyard associated with my interests.

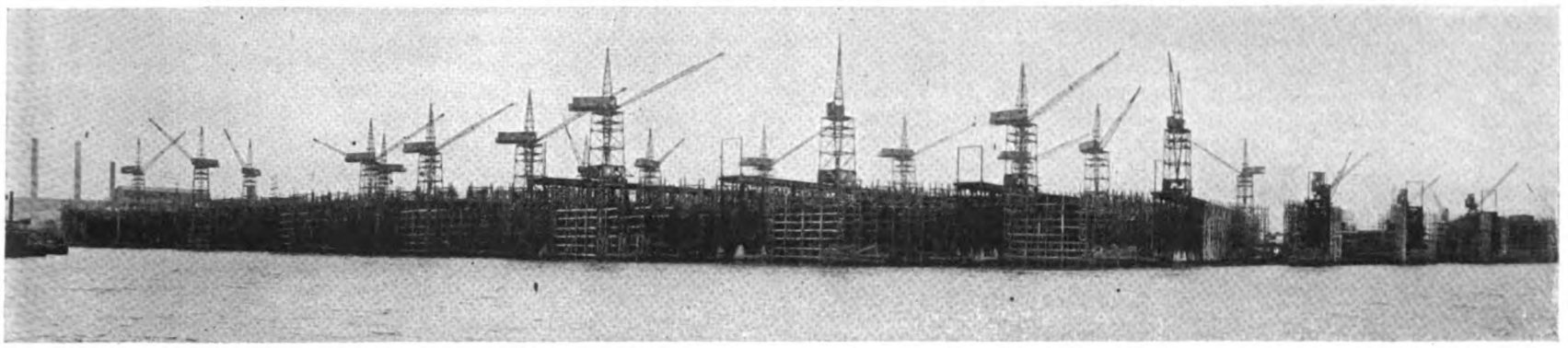
"Certainly it would seem to be evident that the most experienced and successful shipping interests in Great Britain, Holland, Scandinavia, France and Italy are not engaged in their present program of building motorships as a whim, but because they have carefully calculated the economy in operation and are convinced that this economy will enable them to pay dividends even with fuel at high prices, at least, that is the conclusion I have reached.

"The motorship appeals to me," said Mr. Harriman, "not so much on account of the increased net-cargo deadweight and space as on account of the reduced operating expenses. It is, of course, a considerable advantage to obtain increased revenue producing capacity, but the great problem is to effect economy by cutting operating-expenses.

Copyright, Underwood & Underwood

Wm. Averell Harriman, head of the great Harriman shipbuilding and ship-operating organization. His remarks on motorships are of considerable interest.

Generated on 2024-09-13 14:35 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN



Bristol plant of the Merchants Shipbuilding Corp.

The motorship accomplishes that result. It also conserves our fast dwindling oil supply by reducing the amount now used under boilers.

"In my opinion, everything that can make the operation of ships more economical must be adopted by our American companies, large and small, if the great merchant shipping fleet of this country is to hold its own in competition with the numerous economical motorships now in service or building abroad. The latest Lloyd's report gives a clear idea of the rapid strides that this type of vessel has made in Great Britain and in continental Europe.

"America has lost much valuable time because of conditions previously mentioned and much will have to be done during the next few years to catch up in design and construction. There can be no further doubt of the many economies to be gained by the use of internal-combustion oil-engines for propelling and auxiliary power, but one of the principal factors in our present problem is the early construction of Diesel engines of American manufacture as good as or better than those which have been built abroad, and in as high power, or even in larger units.

"I see no reason why American shipyards and engine works cannot together turn out motorships equal in design, construction and operating reliability to anything yet built on the other side of the Atlantic. In striving towards this end, American shipbuilders and engineers should receive the encouragement, co-operation and reasonable assistance of shipowners. My company has shown a lead by ordering the two 11,000 ton motorships now building."

General Problems of American Shipping

Having described the Diesel-ship subject Mr. Harriman turns to more general conditions that are equally important to the success of our shipping.

"I am confident," he remarked, "of the future development of the American Merchant Marine. I believe firmly that it is the intention of this country to support its shipping industry in order that America may regain the place she once held upon the seas, and be sure of a proper participation in international commerce. The future of our country, that is, its destiny, is dependent upon our international commerce, and we cannot properly take our place in the world trade unless we have sufficient well equipped American ships to carry a proper proportion of our exports and imports.

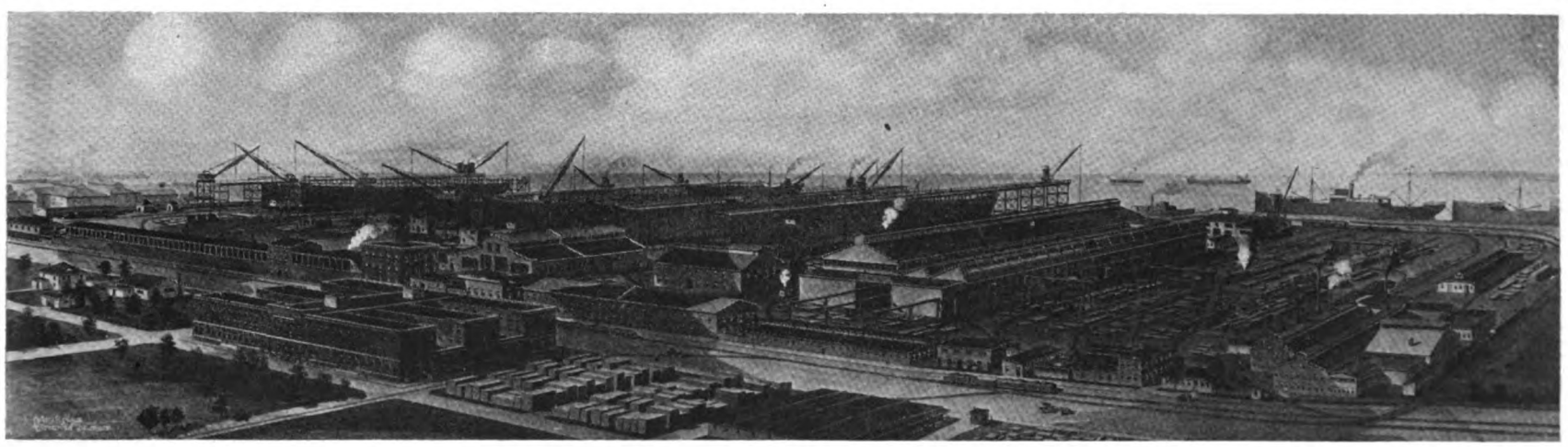
"Let me make it clear that one of the essentials to the development of our merchant marine is a well defined constructive plan of legislation which shall encourage and protect our newly born American shipping industry, so that it may compete for world trade with the ships of other nations on equal terms.

"The passing of the Jones Act by Congress was a splendid step in the right direction. I do not believe there would have been any serious detrimental results to this country if the provision regarding differential rates in the Merchant Marine Act had been enforced. American shipping was asking for differentials which were necessary to put our shipping on the same basis with our competitors and nothing more. I do not believe that there would be any reason to fear any general retaliation. No general retaliation has ever taken place in connection with America's protective tariff policy affecting other industries, and in my opinion no general campaign of retaliation would be started by foreign nations if we gave our shipping the benefit of certain differentials in order to overcome our increased cost. As far as I know no retaliatory measures have ever been adopted by one country against another because of subsidies granted to private shipping-companies by their Governments.

"Another problem of our merchant marine is that which at present faces the Shipping Board. The present system of allocations of many shipping companies by the Shipping Board is affecting the value of privately owned tonnage. I should like to see the Shipping Board take the drastic step of giving ships to operators only on the condition that they will guarantee the Shipping Board in some form or other against loss. Probably the best plan would be to fix a reasonable charge, and turn the operation of the ships over to the charterer with proper guarantees. I have no doubt that in the long run this will mean that a large part of the Government fleet would have to be tied up during the period of readjustment. It would be proper for the Shipping Board to continue certain services in the hands of operators under assignment in order, as contemplated in the Jones Act, to develop services which will help American trade and which in the future may become profitable. It seems better to tie up the tonnage that is surplus until conditions justify its employment than to operate such tonnage at a loss. I have no doubt that in the long run this policy will save the Government many millions of dollars, and give a chance for a sound development of private enterprise and eventually mean the sale of the ships at a fair price.

"Another essential is the support of American shipping by American exporters and importers and the general public. In order to encourage shipping under their own flag, American exporters should give preference to American ships wherever possible, and in addition they should be willing, whenever it is necessary, to undergo some inconvenience and delay of shipments in order to ship in American bottoms.

"Furthermore I consider that it is necessary for the public generally to support American shipping through investment in responsible shipping companies. American shipping securities are not well-known throughout the country, and are regarded as being highly speculative. They should become as widely known and as popular as railroad or industrial securities. This is the case to-day in Great Britain, and should be



Chester plant of the Merchants Shipbuilding Corp. where two 11,200 tons d.w. motorships are being built.

Generated on 2024-09-13 14:36 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

the case in the United States. Our people generally should have confidence in the development of the American Merchant Marine. They should be made acquainted with the essential part it plays in the prosperity and progress of our country, and should realize how necessary is their support for the American Merchant Marine to obtain its proper development."

Contract with the Hamburg-American Line

So much has been said in the daily press about the new relations between the H. A. L. and the Harriman shipping interests, and such a lot of misleading statements have been hashed by reporters, that this interview would have been incomplete without more or less of a reference, so we requested a clear outline of the actual facts from Mr. Harriman.

"Before answering your question," said Mr. Harriman, "I should point out that American shipping is now engaged in world-wide open competition. The struggle for world trade has never been more active and is being carried on in every quarter of the globe. One of the principal objects of this competition is naturally the large volume of business done by German shipping before the war. Germany in 1913 had a merchant marine tonnage of more than 5,000,000 tons; to-day it has only about 419,000 tons. The trade represented by this nearly 5,000,000 tons which Germany has lost must therefore be carried on by the ships of other nations.

"The reasons for making the contract by the American Ship and Commerce Corporation, with which I am connected, with the Hamburg-American Line are very simple. The Hamburg-American Line was before the war the largest shipping Company in the world, and at the present time is easily the largest shipping company in Germany. It has unequalled port facilities in Hamburg and other German ports, and a large trained organization with an experience of a quarter of a century in handling foreign trade.

"Under the agreement the Hamburg-American Line places its technical knowledge and all its experience in the construction of ships and the development of shipping business at the disposal of the American Corporation. It acts as the agent in Germany of the American Company. The American Company in its turn acts as the agent of the German Company in this country, and has the right of equal participation with the Hamburg-American Line in all trade routes formerly served by that line.

"The agreement in this way affords the opportunity to place immediately upon the most promising trade routes of the world ships flying the American flag. In fact, the advantages of such an arrangement were recognized more than a year ago by the United States Shipping Board. On July 14th, 1919, the War Trade Board Section of the Department of State issued a general license permitting resumption of trade with Germany. Conversations were begun by the Shipping Board with the Directors of the Hamburg-American Line, and the agreement concluded by the American Corporation is the result of these conversations, and has had the full approval and endorsement of the Chairman of the Shipping Board.

"I may point out as an indication of the growing importance of this trade with Germany, that there are at the present time more than 50 shipping lines running out of Hamburg, including 10 British, 8 Dutch, 7 German, 6 Scandinavian, 5 American, 2 French, 2 Japanese and 1 Brazilian. The vessels employed by my Company on the services operated in connection with the Hamburg-American Line are privately owned. No vessels belonging to the United States Shipping Board have been allocated to the services, and no request has been made upon the Shipping Board for vessels for this purpose."

* * *

It is fitting to follow Mr. Harriman's absorbingly interesting remarks with some details of the vast combination of shipbuilding and ship-operating interests which his fore-sight has caused him to bring together "under one roof" as it were. These industries and business represent many accumulated experiences from years of practical work in the shipping field, and are totally unlike the enormous "war-time" organization built-up by the Government from unexperienced labor and practice, and which has decayed since the Armistice instead of improving, and by which our foreign competitors erroneously judge America's powers for shipbuilding and operating. With a fleet of fifty modern economical motorships in service, we feel convinced that such American organizations as the Harriman could more than hold their own against the steamships of all other maritime nations. Therefore, let us hope they will soon control such a fleet.

Shipowning Companies

Shipowning companies known as the Harriman Lines include the following:

The American Ship and Commerce Corporation.

The American Ship and Commerce Navigation Corporation.

The American Hawaiian Steamship Co.

The Coastwise Transportation Company.

The Shawmut Steamship Company.

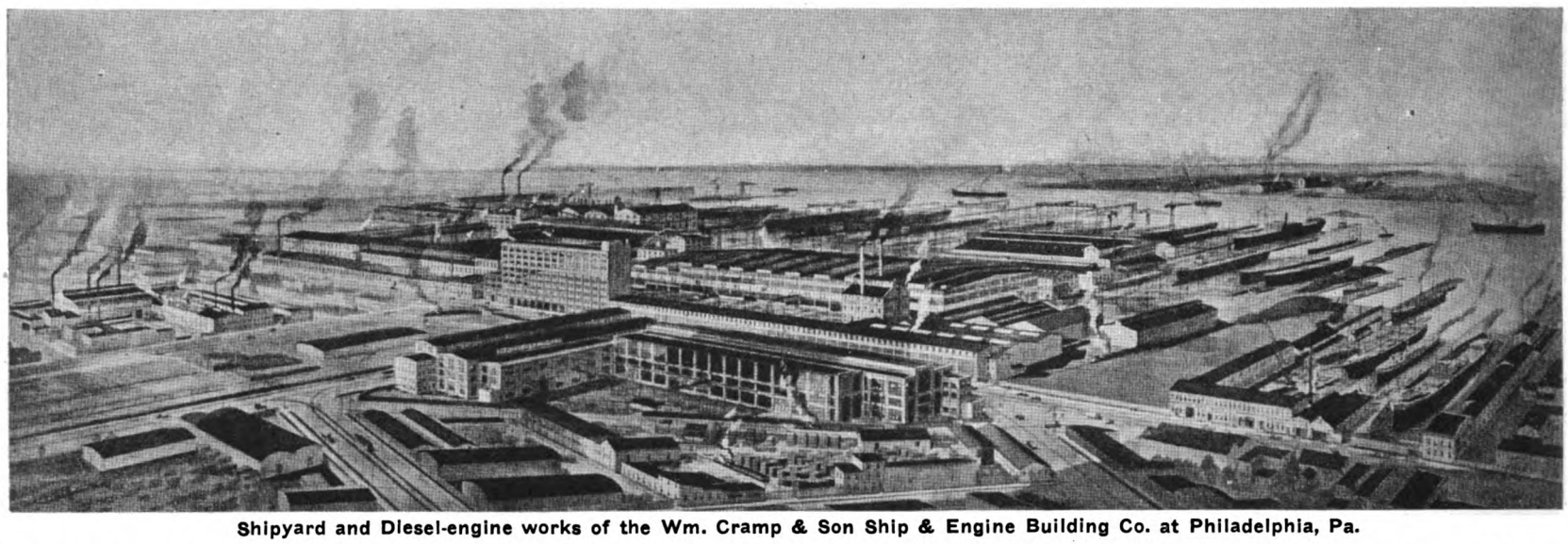
The United American Lines Incorporated.

The last named concern is the operating organization acting as managing-agents for both the American-Hawaiian and the American Ship & Commerce Corporation fleets. It may be remembered that the American Ship & Commerce Corporation was organized on July 18, 1919, under the laws of the State of Delaware; but it is purely a holding company. Its subsidiaries are the William Cramp & Sons Ship & Engine Building Company of Philadelphia, who control the rights in the Eastern section of the United States for the Burmeister & Wain four-cycle type marine Diesel-engine.

The American Ship & Commerce Navigation Corporation, has a fleet of ten freight steamers with a total tonnage of 77,000 tons d.w.c. and in addition, the steamer "Mount Clay," ex "De Kalb," is now being reconditioned for third-class passenger service. The ten other vessels owned by this corporation are as follows:

Mount Bliss	Mount Sherman
Mount Brace	Mount Sherrill
Mount Bowdoin	Mount Sidney
Mount Seward	Mount Sterling
Mount Sheridan	Mount Summit

Here it may be mentioned that this Navigation Corporation also owns practically the entire stock of the Shawmut Steamship Company, which has three modern freighters aggregating 25,000 tons d.w.c., and is building two 10,500 tons d.w.c combination passenger-freighters for the third-class passenger service between Germany and the U. S. A.



Shipyard and Diesel-engine works of the Wm. Cramp & Son Ship & Engine Building Co. at Philadelphia, Pa.

One of the most important of the shipping companies in this big combination is the old American-Hawaiian Steamship Company, which for many years has been one of the most important in the United States. Prior to the war their vessels were engaged in coast-to-coast service to Hawaii through the Panama Canal calling at Atlantic and Pacific ports, but during the war many ships were converted to ocean traffic. They have always been the pioneers in adopting new types of ships and mechanisms, and were the first shipowners in the U. S. A. to adopt oil-firing under boilers. Then they followed by being the first American shipowning company to order two large ocean-going motorships. These motorships are being built by subsidiaries of the Harriman combination and will be referred to later.

Upon the death of Mr. George S. Dearborn in May, 1920, Mr. Wm. Averell Harriman then senior Vice-President, became the ac-

Generated on 2024-09-13 14:32 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

tive head. The fleet of the American-Hawaiian Steamship Company is as follows:

Name	Tons Deadweight	Name	Tons Deadweight
Alaskan	13,112	Ohioan	10,165
American	8,060	Oregonian	8,060
Arizonian	14,180	Panaman	10,165
Dakotan	10,165	Pennsylvanian	10,165
Floridian	10,315	Texan	13,888
Hawaiian	8,060	Virginian	11,207
Iowan	10,165	2 motorships building	11,200
Kentuckian	9,945		
Mexican	13,761		
Minnesotan	10,165	Total	194,987

Another shipping company is the Coastwise Transportation Company, which is a subsidiary of the American-Hawaiian Steamship Company, and owns ten vessels that with one exception are in the collier business.

With the end of combining the operation of the ships owned and controlled by the American Ship & Commerce Corporation, the well-known operating firm of Livermore, Dearborn & Co. was acquired. Fifty per-

Ship & Commerce Corporation was originally the Kerr Navigation Corporation and that 94 percent of the stock is now owned by the first mentioned concern.

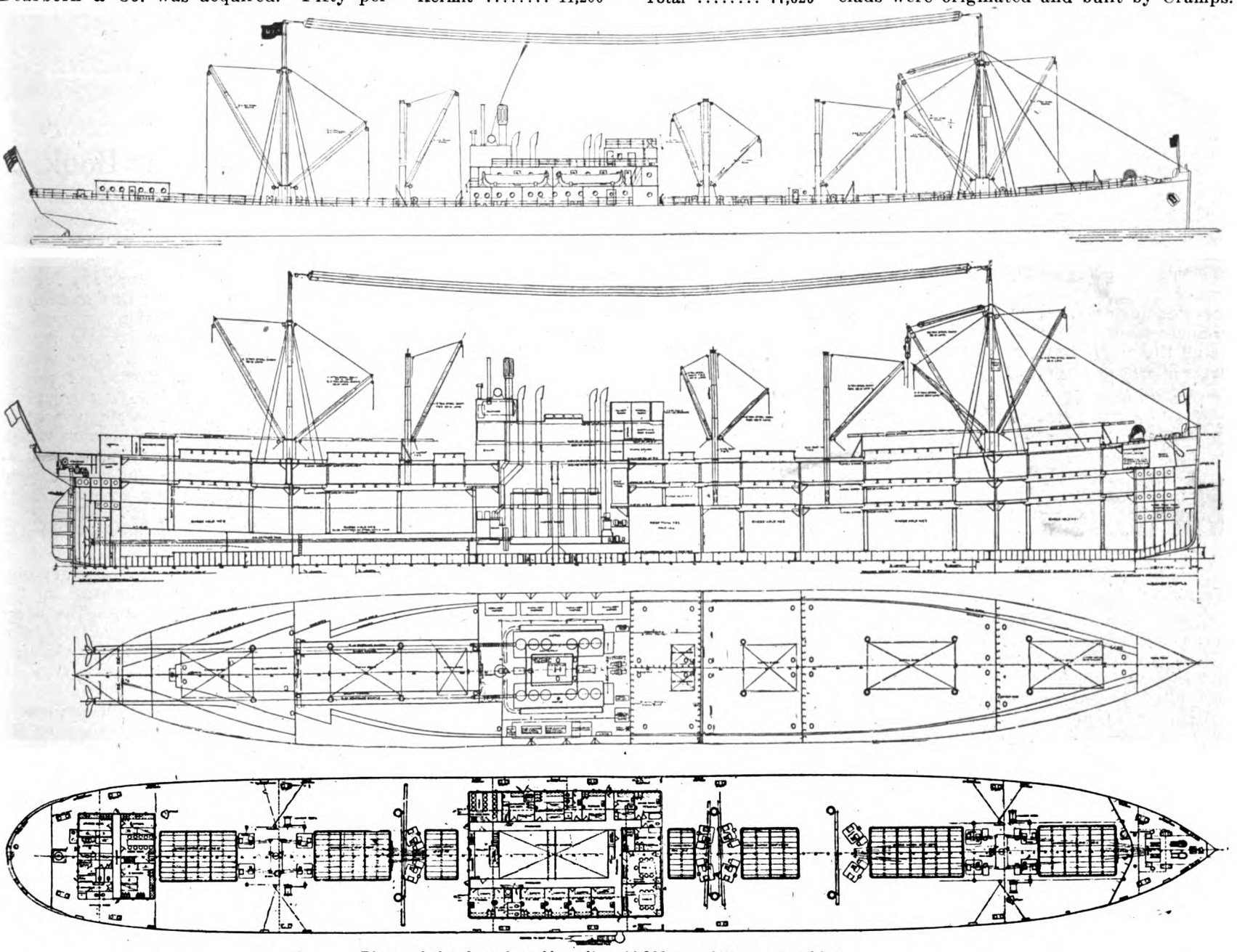
The Kerr Steamship Company—now quite separate from the Harriman interests—originally operated the fleet of ships for the Kerr Navigation Company, and these vessels have now been turned over to the American Ship & Commerce Navigation Corporation. Today these vessels are being operated between New York and Hamburg, and between Hamburg and the South American ports and Rio de Janeiro, Santos, Montevideo, Buenos Aires and the River Plate, This fleet is composed of the following ten ships:

Name	Tons Deadweight	Name	Tons Deadweight
Keresan	6,780	Kermoor	6,980
Keressepa	7,300	Kerowleo	6,080
KerKenna	5,500	Monticello	11,200
Kerlew	4,805	Montpelier	9,675
Kermanehah	8,100		
Kermit	11,200	Total	77,620

yards and one new yard. To readers of "Motorship" the most important of these is the Wm. Cramp & Sons Ship & Engine Building Company, of Philadelphia, as this concern owns the license for the Burmeister & Wain Diesel engine, and is building Diesel engines for two motorships for the American-Hawaiian Company.

Furthermore, they are at present installing a pair of Danish built Burmeister & Wain engines in the 12,500 tons motorship "William Penn" owned by the United States Shipping Board.

It is hardly necessary to say that the name of Cramps has become a part of the history of American shipbuilding and has figured largely in naval construction work, as well as in merchant shipbuilding during a period of about 90 years. As far back as the Mexican war its contributions to the United States Navy solved the problem of landing troops. During the civil war the great battleship "New Ironsides" and other ironclads were originated and built by Cramps.



Plans of the American-Hawaiian 11,200 ton d.w.c. motorships.

cent interest in this business was obtained by the American Ship & Commerce Corporation and the other fifty percent by the American-Hawaiian Steamship Company, and the name of the operating company was changed to the United American Lines Incorporated.

Ship Operating Organization

We should not omit to mention that the American Ship & Commerce Navigation Corporation which is owned by the American

Also on January 1st, last, a monthly service was started between Hamburg and Brazilian ports and since have been increased to fortnightly sailings, while the service between New York and Hamburg has weekly sailings. Early in the coming year a third-class passenger service betwen New York and Hamburg will be incorporated for three ships of about 13,000 tons d.w.c. each.

Ship and Engine Building

The Harriman organization, as previously mentioned, includes two old established ship-

Many of the American war-vessels participating in the war with Spain were of Cramp construction, and many of the vessels of the present United States Navy were built in its yards.

During the war period alone, the United States Navy Department contracted with Cramps for 55 ships. The United States destroyer "Cole" with the world record speed of 47 statute-miles per hour, the latest type of destroyer, was a product of this plant. Cramps is the only American ship-

Generated on 2024-09-13 14:36 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

building company that has built trans-Atlantic liners of the first class.

The plant occupies 168½ acres, of which 47 acres are devoted to the main plant where are located light building-ships, wet-basins, store-houses, power-houses, foundries, etc. There are more than five miles of standard-gauge railroad track serving this plant. In addition there are the Kensington Shipyard and Dry Dock Department, Petty's Island of 108 acres and the Federal Steel Foundry Company.

Next we will refer to the Harriman yard at Bristol. This really is a United States Shipping Board, Emergency Fleet Corporation agency yard, the plant originally having been constructed and operated for the Government in connection with the Emergency Shipbuilding program on land belonging to the Emergency Shipbuilding Corporation. It has river frontage of 3600 feet and contains about 260 acres of which 80 acres is utilized for townsite and steel storage yard.

On September 17, 1917, this Corporation entered into a contract with the Fleet Corporation for the construction of 40 cargo vessels, each of 8800 to 9000 tons d. w. They were fabricated steel freighters constructed to the designs prepared by the Merchant Companies' Chester yard organization and are equipped with Westinghouse turbines of 3000 h.p. with three B. & W. boilers using oil-fuel.

The adjacent town has been named "Harriman" and has a post-office, hotel, modern hospital, 206 group houses, 26 single houses, 26 duplex houses, and 212 apartment houses, besides a large number of boarding houses, bachelor quarters and bunk houses sufficient to house about 3000 men and their families. As all this work was carried out during the stress of war conditions, you will realize it is quite a big job.

Finally, we have the plant of the Merchant Shipbuilding Corporation located at Chester, Pa., which was one of the oldest in the country, having originally been organized about 1859 under the Management of Reaney Son & Archbold Company but taken over in 1871 by John Roach who, in the following year organized the Delaware River Iron Shipbuilding and Engine Works, which became famous because of the quality of its product.

In the early days of the war this plant was purchased by Capt. C. P. M. Jack who organized the Chester Shipbuilding Co., Ltd., and operated the same until February, 1917, when Mr. Wm. Averell Harriman purchased it. During the interim period the shipyard has been improved and expanded and is now one of the most modern and best equipped plants in the United States. There are now 7 slipways, together with fully equipped shops for the construction of ships up to 15,000 tons d.w.c. and with provision for extension to accommodate much larger ships. At this yard the hulls of the two 11,200-ton d.w.c. motorships are being built.

During the period since America's entry into the war mostly standard freighters and tankers and a few auxiliary vessels for the Navy Department were turned out at this plant.

Finally we will deal with the two motorships building by the Merchants Shipbuilding Co. at Chester for the American-Hawaiian Steamship Co. Each has the following dimensions:

Displacement (loaded)	16,500 tons
Displacement (light)	5,300 tons
Weight-cargo Capacity (on 10,000 miles voyage)	10,460 tons
Dead weight capacity	11,200 tons
Total Cubic-Capacity	587,200 cu. ft.
Speed	11.5 knots
Daily Fuel Consumption	15 1/3 tons
Length (O. A.)	461 ft., 10 in.
Length (B. P.)	445 ft.
Breadth (moulded)	59 ft., 8. in.
Depth (moulded)	39 ft.
Mean Loaded Draught	28 ft., 6 in.
Cubic Capacity of Hold	524,228 cu. ft.
Cubic Capacity of Deep Tank (used solely for cargo)	880 tons or 35,200 cu. ft.
Fuel-Capacity	1,475 tons
Cruising-Radius	24,000 nautical miles
Drinking-Water	87 tons
Shaft horse-power	3,600
Indicated horse-power	4,500
Engine Speed	115 R.P.M.
Daily Lub. Oil Consumption	12 gallons
Port Fuel-Consumption	1¼ tons
Length of Machinery Space	55 ft., 6 in.
Engine Cylinder Bore & Stroke,	740 mm. x 1150 mm.
Auxiliary Diesel Engines	Four of 100 b.h.p.

The B. & W. four-cycle type Diesel engines of this vessel, as we previously have mentioned, are being constructed by the Wm. Cramp & Son Ship & Engine Building Co. For auxiliary purposes, including for generating electrical power for the deck winches, four 100 b.h.p. Diesel-engines will be installed. There will be fourteen 5-ton electric winches and two 30-ton winches working at 150-200 ft. per minute.

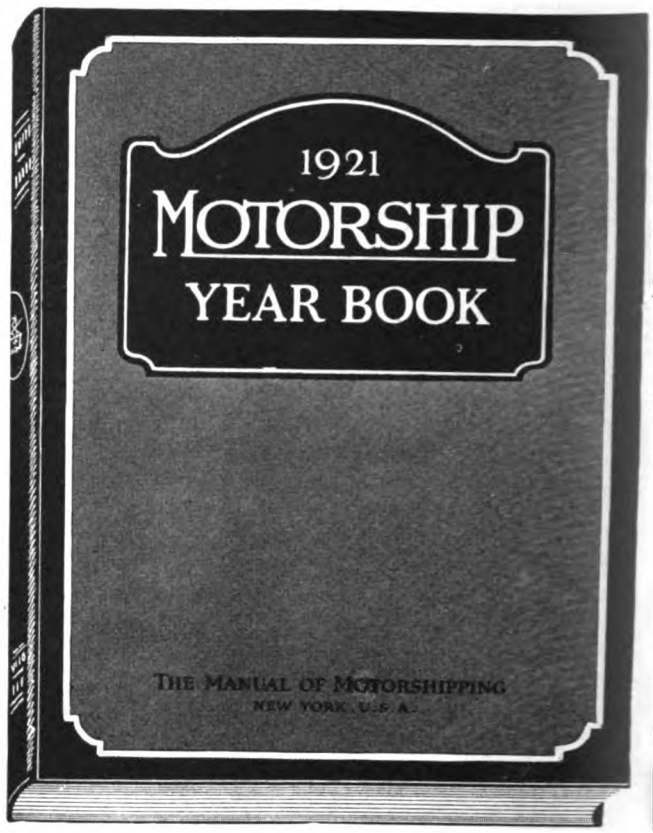
We draw the attention of steamship owners that, while the loaded displacement of either vessel is but 16,500 tons she will carry 587,200 cubic-feet of cargo (or 10,460 tons) in addition to a proper supply of fuel, water and stores, at 11½ knots speed on a daily-consumption of 15 tons of fuel. Compared with a steamship of the same loaded-displacement and speed she carries at least 12 per cent more weight-cargo or about 10 percent more bulk-cargo, and only uses one-third the amount of fuel to do it. Yet the dead-weight capacity (an obsolete term) is almost the same.

KRUPP TWELVE-THOUSAND SHAFT HORSE-POWER MARINE DIESEL-ENGINE

Referring to our remarks in the September issue of "Motorship" regarding the Krupp 12,000 shaft h.p. double-acting two-cycle marine Diesel-engine, Messrs. Krupp, of Kiel, write to state that this six-cylinder engine was actually running shortly before the war, it having been completed for a new class of battleship following the pre-war experiments with the single-cylinder 2,000 b.h.p. engine. They state that the engine itself was a success and that our remarks as published on page 799 of our September issue are correct on the whole.

Tests were carried on during the first part of the war, but owing to the urgency of submarine engines, this engine was put to one side. After the war the German Government naturally had no use for this engine, and Krupps have temporarily dismantled it, owing to the demand on their space for Diesel-engines for merchant-vessels.

American shipowning companies interested in high-powered transatlantic liners could with benefit carry out negotiations for the purchase of these engines from the German Government through Messrs. Krupp. The possession of such high-powered Diesel engines would be of incalculable value to the development of the motorship in the United States.



Our First Year Book

Important Catalogue Section

We particularly draw the attention of manufacturers, ship operators and other readers in the industry, to the announcement on another page of this issue of *"The Motorship Yearbook"* which is the first annual review issued by this publication.

The success of the book will partly depend upon the co-operation of firms in the motorshipping and allied industries, as it partly rests upon them to furnish very complete material for the important catalogue section of this Yearbook. With such co-operation this work will form a very valuable book of the late developments in the marine field upon which all shipowning eyes are now forecast.

Among valuable data in the editorial section will be the most complete record of every motorship in service and on order that has yet been published anywhere in the world, of from 200 to 8000 i.h.p. The name and address of shipowner and builder, size and capacity of hull, and the power and speed of the engines will be given in all cases. There will be information on the operation of merchant-ships' Diesel engines at sea, and useful questions and answers for men about to take examinations as engineers of Diesel ships. Then again there will be a very handy map of all the oil-bunkering stations of the world. The entire book will be profusely illustrated and include many typical examples of modern merchant motorships.

The catalogue section—*the support of which is earnestly requested of manufacturers*, will contain leading types of Diesel and surface-ignition oil-engines for propelling and auxiliary purposes, deck and engine-room machinery and equipment, electrical devices, fuel and lubricating oils and the products of shipbuilders and repairers specializing in vessels of this type. There are many manufacturers in the allied trades whose product also applies to general steamships, and who may not yet be sufficiently conversant with the motorship building industry to warrant their taking regular advertising space in the monthly issues of "Motorship." To these companies the catalogue section of the Yearbook should strongly appeal, as it will form a permanent record until issuance of the second of the series in 1922.

Generated on 2024-09-13 14:35 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

A World View of the Oil Supply

By GEORGE OTIS SMITH
(Director U. S. Geological Survey)

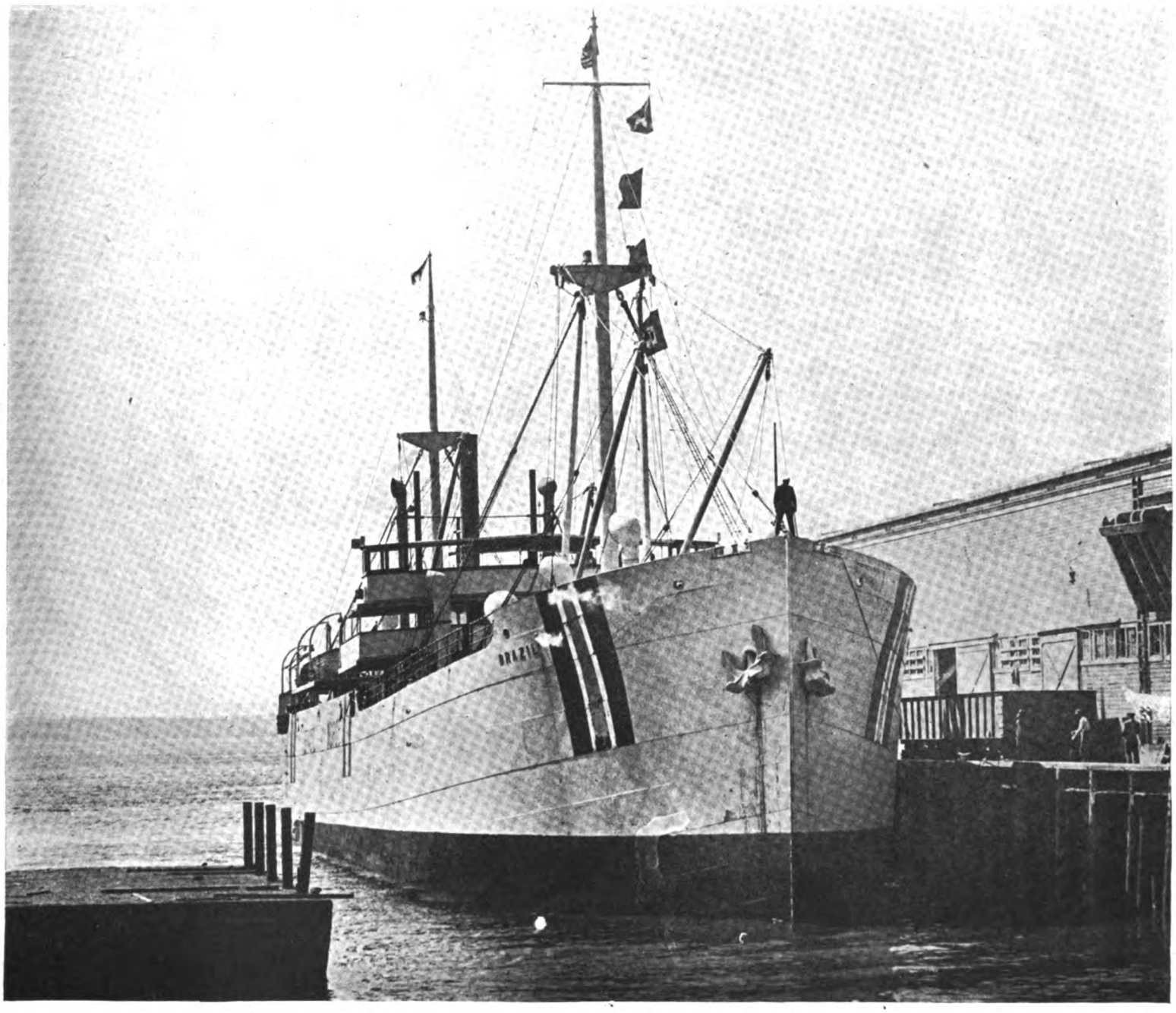
Extract From Paper Read Before American Petroleum Institute at Washington, Nov. 17th, 1920

IN acknowledging the superior claim of the marine use of fuel-oil, this priority must be qualified by the condition that even on the seas the best use should be made of the invaluable fuel. The marine steam-engine, even of the turbine type, must give place to the heavy-oil engine, under the rule of getting the most out of a limited resource. The very facts that support the argument for the marine use of fuel-oil—greater efficiency and economy of space and labor—can be cited in favor of the internal-combustion engine of the Diesel type as against the steam-engine. The increased thermal efficiency of the new engine with its resulting addition to available cargo space or to cruising radius, is more than 2½ times that of the steam-engine. The experience of the Bethlehem Steel Co., is that their new oil-engine ore-carrier, the "Cubore," in continuous service between Cuba and Sparrows Point, Md., uses only 36.7 per cent. of the fuel-oil consumed by a sister-ship differing only in that it has the most modern type of steam plant. The tremendous economy thus possible in the marine consumption of fuel-oil demands the immediate adoption of internal-combustion engines if the world wants to make the largest use of its oil resources for the longest time.

The century just past has witnessed the conquest of distance. Glance at the roll of the conquerors who have brought the remote nations of the world closer together than the thirteen colonies were in the days of Washington—the clipper-ship, the transoceanic cable, the ocean-liner, the transcontinental railroad, the wireless-telegraph, the oil-burning steam turbine, and now the Diesel-engine. Each of these has played its part in tying together the hemispheres, until at least a physical basis has now been established for a neighborhood of nations.

Commerce is more than exchange of commodities; it is the intercourse of nations, and through commerce nations associate. Oil as the best servant of commerce thus takes on large international interest. The same factors that make oil absolutely essential for naval use qualify it for merchant-marine strategy. Observers who are keenest in watching for war clouds on the distant horizon see in the world's growing need of oil and the uneven distribution of the world's supply the promise of war. Yet we are warranted in looking upon oil as also a possible agency of peace, for by permitting lowest-cost operation of the merchant-marine, it promotes the broadest intercourse between nations.

Austria, bankrupt in fuel, having lost her coal and oil, has begun to electrify half her railway mileage. Shall our nation wait until we too are bankrupt before awaking to the need of a change in sources of power? The program of conservation through electrification has started, and while this simply emphasizes our future dependence in larger measure upon coal it should at once make us abandon fuel-oil as a source of motive-power for our railroads and industries. In a word, the world has not oil enough to burn under either stationary or locomotive boilers.



The Norwegian motorship "Brazil" at a U. S. Pacific Coast Port. It is such vessels as this that will carry American products when cargo shortage, competition and rate-cutting, already started, causes our uneconomical steam-driven ships to be held in harbor rusting.

Generated on 2024-09-13 14:35 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Contents copyright 1920 by Miller Freeman & Co.

MOTORSHIP

Trade Mark, Registered

Published Monthly in the Interests of Commercial and Naval Motor Vessels and for Recording International Progress of the Marine Internal-Combustion-Engine

Head Office: 1270 BROADWAY, NEW YORK, N. Y.

149 California Street, San Francisco 71 Columbia Street, Seattle, Wash.

Published by MILLER FREEMAN & COMPANY

MILLER FREEMAN.....President
THOS. ORCHARD LISLE.....Editor
A. M. S. Naval Engineers. A. M. I. Marine Engineers
RUSSELL PALMER.....Manager
GEO. F. FARRAH.....Advertising Manager

Subscription rates: U. S. A. and Mexico, $3.00 per year. Canada and foreign countries in the postal union, $3.50. Single copies, United States, 25c. Great Britain, 1/6. Other countries, 35c.

"Motorship" is published on the 25th of the month prior to date of issue, and all changes in and new copies for advertising must be in the hands of the publisher prior to the 5th of each month. Notice of discontinuance of advertising must be given before the 1st of the month, preceding issuance.

MORE ON THE CONTROVERSY OF THE CYCLES

A shipowner from Mars—one of the big operators on those much-discussed canals let us assume—might be forgiven, if, on his first visit to this planet to pick-up new wrinkles in the business, he should become confused by the arguments surrounding the various species of the genus Diesel. Instead of becoming duly converted to the oil-burning engine, he might tell us in his farewell interview that, though he's sure we are on a good thing, he will wait until we seem to be more of one mind on this very good thing. He might even express the opinion that the Martian Shipping Board would shrink from taking-up this type of engine, in view of the glorious opportunity the politicians would have with so many different contending parties to feed the batteries of criticism and supply the mortars with mud. Comfortably settled aboard his flying packet, speeding into the ethereal blue, he might, as our efforts became more closely focused to his view in the growing distance, shoot back at us from the stellar regions the friendly radio message: "Get together, boys!"

We do not know that there are shipowners on Mars; we do not know what they would think of us if there are any and if they could get here; but we do know that somebody is "rocking the boat," and it may be you or it may be the other fellow or it may be both of you. We—it is the editorial "we" expressing itself now—see more of this than you do, and we feel it more. "We" are the combination, "we" gather the news, "we" hear the opinions from all quarters, "we" listen to what you have to say, "we" are told what all and sundry are thinking, and "we" have to screen it over a broad mesh and sort it, and often get many knocks as we shake the sieve.

Two-cycle and four-cycle, opposed-piston and double-acting, air-injection, solid-injection, straight-drive and Diesel-electric, we hear all of them. Each proponent claims the only system. That is all right up to that point, but it is not all right when the argument swings over to "knocking" the other systems. It is not only enough to put forward the relative advantages of the system one desires to boost, but it is positively damaging to the industry to go beyond that point and decry the other systems. Everybody should stand firm on this basis, that *all the reputable Diesel-engines are good,* no matter which system of operation they incorporate. If everybody follows that commonsense rule there will be less confusion in the minds of the shipowners who are studying the oil-engine. We address these remarks to all our readers, without special reference to any and with exception to none.

For further clarification we will make the observation that there is a wide distinction between the true technical discussion of the different systems and the discriminate "knocking" against which we are now protesting. It is good and useful for shipowners to relate their experiences with various types and to explain their preferences; it is commendable for designers, engineers and shipbuilders to publish their views on differences in types; *our columns are open for that purpose,* because the publication of such opinions makes for progress and the results are very valuable. Where there are many types, manufacturers must choose and shipowners must select, simply because the one cannot build all types nor the other use all of them.

In such a choice, however, there is no exclusive virtue. The preference of one man does not condemn the preference of another, and hindsight is the only arbiter of the wisdom of a man's judgment. The adherent to the four-cycle type should not say the two-cycle system is no good, any more than the protagonist of the two-stroke engine should say the four-stroke motor belongs to a past age. To deride the opposed-piston or double-acting designs is to lay oneself open to repentance, for who can tell what the future holds for these types. If the next ten years provide as great a development for the marine oil-engine as the last ten years have witnessed, then indeed a forecast is impossible. We have marked and noted many things that 1910 did not promise in this field of endeavor, and we miss many things that were predicted. Between now and 1930 we anticipate much progress, but to attempt to define it we shall not. We have great faith in this industry, a faith which has strengthened with each passing year since a time, which seems long ago, when we expectantly awaited its birth. Because of that faith our experience in this line is old, as old as the industry. From the fund of that experience we draw a warning about the pitfalls and dangers of condemning all types except the one you favor. It rocks the boat! The stranger from Mars would be dead-right with his advice about getting together.

STANDARDIZATION AND COST REDUCTION

By dint of standardization, quantity construction and modern tools and shops, the cost of building ship's Diesel oil-engines in the three Harland & Wolff plants at Glasgow can now be turned out more rapidly and at a cost very little in excess of reciprocating steam-engines and boilers.

Similar quantity production and standardization in this country has been stunted, because shipowners have not ordered sufficient numbers of motorships at one time to enable engine builders to accomplish results. Consequently the cost of American Diesel-engines is somewhat high and the time of delivery comparatively long. Excellent standardization would have been possible with the big order placed by the Shipping Board over two years ago had not work on their production been held back and half the order cancelled owing to no hulls having been provided to take the machinery.

None of our shipowners has yet placed orders for half a dozen or more twin-screw motorships at a time, as has nearly always been done in Europe since the first Diesel-driven motorship crossed the ocean in 1911. Look at the example of such companies as the East Asiatic Co., Transatlantic Co., Rederi-Nordsjernan, Bibby Line, Otto & Thor Thoresen Line, Pacific Steam Navigation Co., Anglo-Saxon Petroleum Co., Tankers Ltd., Dutch Royal Packet Co., Grangesburg Co., the Dan Brostrom Lines, Winge & Co., British India Steam Navigation Co., Caucasus & Mercury Co., Nobel Bros., Lane & McAndrew, and the Societa de Nazionale di Navigazione, and others.

Here we have listed nearly twenty well-known foreign shipowning concerns, all of which have demonstrated sufficient foresight and confidence in the motorship to order four and upwards at one time, the Grangesberg Co. recently ordering no fewer than 16 Diesel ships of 7,500 tons each *en bloc;* while way back in 1910 when it was more or less risky the East Asiatic Company ordered three 7,000-ton motor-freighters at one go, on the assumption that if one could be successful all three would be equally good. We have yet to learn of anyone of these experienced ship-operators having regretted their enterprise, which fact American shipowners might ponder over. When our shipowners commence ordering motorships in the quantities adopted by their more experienced competitors across the Atlantic, our engine biulders will be able to standardize, and the situation of high costs and slow deliveries will no longer exist. The four big ore-oil carriers to be built by the Bethlehem Steel Co. is the first step in this direction.

OUR EDITORIAL PAGES

As previously indicated, we have made arrangements for all the leading writers of all countries on marine heavy-oil engine and motorship subjects to regularly contribute to "Motorship"—in some instances exclusively. It is our intention to maintain our lead as the most valuable and progressive merchant and naval marine publication in the world.

ANOTHER SHIPPING BOARD MYSTERY

Recently a Shipping Board vessel of about 12,000 tons deadweight ran trials equipped with turbine-electric-drive. This vessel was originally placed in service nearly two years ago with turbine and gear-reduction drive, and lately was re-equipped with her present electric plant. So far, so good, as development and experiments should be carried out by the Board as long as it is operating merchant vessels, particularly should progress and tests been made

Generated on 2024-09-13 14:44 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

with electric-propulsion, which holds promise of extensive adoption in the future.

Recently the N. Y. "Journal of Commerce" announced that as the result of the trials of the electric ship in question (and before the vessel had completed a test in the way of a long ocean voyage) the Board would equip no fewer than ten ships with turbine-electric drive, and that a contract had been placed for ten sets of generators and motors.

Now for the mystery! Why is it that the Shipping Board can find money and hulls for the turbine-electric drive, but does not seem to have funds or hulls to test out the Diesel-electric drive, even though Admiral Benson some time ago asserted his belief that the latter class of power was likely to prove the more superior? Why are not some of the ships that have been laying-up because of faulty turbine reduction-gear mechanism converted to Diesel-electric drive? Surely at least one vessel should be tried out!

Furthermore, the Government steamer "Yellowstone" was recently converted from oil-fired boilers to coal-burning, with resultant loss of speed, with the permission of the Board at a cost of $270,000.00. We think we are entitled to ask why was not this vessel converted to direct Diesel, or to Diesel-electric drive, as the cost would not have been much higher, and the fuel-bill would have been reduced to one-third, and at least 10% would have been added to her cargo-capacity? However, it is possible that the bill for the above has not yet been allowed by the board.

Recently the geared-turbine driven steamships "Imlay" and "Westboro" had their propelling machinery removed, and replaced with reciprocating steam-engines. It will be of considerable interest to know why the opportunity was not taken by the Board to instal Diesel-engines in these vessels and thus give these ships maximum operation economy. The new reciprocating-engines are of 2800 i.h.p. Oil-engines of this power could be obtained within six months from several leading American builders.

Evidently many of these conversions and experiments must be done by minor officials of the Fleet Corporation or Board without the full knowledge of Admiral Benson, whom since his appointment to the Chairmanship has been overwhelmed with work, making it impossible for him to be aware of everything that transpires. Knowing his interest in the Diesel-electric drive, we draw his attention to the above conditions.

ENDORSEMENT OF "MOTORSHIP'S" POLICY

According to the New York "Times" of Oct. 30th, the President of one of the largest oil-producing companies stated that it is highly essential that oil supplies be conserved, or else the world would experience a shortage beyond possibility of correction, and that burning of oil under boilers is extravagant to the utmost degree so oil should be used in Diesel-engines and in the form of gasolene in "gas" engines. The "Times" added that some corrective plan must be applied, forcibly and quickly if anything approaching conservation is to be obtained.

LOSING VALUABLE OPPORTUNITIES

Without desiring to "pat ourselves on the back," as it were, it is probable that without a journal such as "Motorship"—which has fearlessly fought the battles of the motorshipping industry—the latter to-day would be in a very feeble state, if not practically wiped out. There is no co-operation among builders or designers, no association or society to educate the shipping and general public, and no one to combat the onslaughts of the steam-engine and boiler interests or other opponents of the Diesel motor except this lone publication. More co-operation in the industry is urgently needed, as is indicated in another editorial in this issue; also it is essential for individual Diesel-engine builders to assist their own work, which is also our work; several of them not even supporting "Motorship" and its big task by using our publicity pages, and some only in a very modest way.

The annual meeting of the American Society of Naval Architects & Marine Engineers has just been held. The Secretary invited the engineers of a number of leading Diesel engine building firms to read papers before the members at this meeting; but one and all either excused themslves for various reasons or declined the honor, excepting one whose paper did not mature in time. Consequently the Diesel-engine and motorship were entirely neglected at this important meeting, and all the treatise and discussion were about steam-driven vessels. Papers on the motorship subject would have furnished valuable publicity at this moment. Obviously the necessity for whole-hearted support to "Motorship" is greater than ever. Are you doing your share?

FIVE-MILLION DOLLARS FOR NEW MOTORSHIPS

We have before us a letter from the Vice-President of a well-known New York Steamship Company who have nearly $5,000,000 in reserve for new merchant ship construction, and which will be used in the very near future to build vessels under the regulations of the Jones Merchant Shipping Act, whereby they will be exempt from excess-profits tax if the money in question is invested in new ships. An important official of the company in question writes that plans are now before them regarding future building, and advises us to rest assured that these vessels will be motorships,—as under no circumstances would he—as Director of Operations—advise his company to invest their capital in obsolete steamers. Furthermore, when their plans are near maturity our co-operation will be requested.

Naturally, it would not be ethical for us to publish the name of the shipowning firm in question at this time; but, to ship and engine-builders interested we see no objection to giving further information.

BRITISH CONTEMPORARY MAKES A SLIP

We were rather surprised to see our esteemed contemporary, "Shipbuilding & Shipping Record"—which usually is very careful and conservative in its statements—recently made a faux pas. Referring to the question of power transmission for ships in an editorial in its October 21st issue, the editor said:

> *"Both the steam-turbine and the Diesel-engine suffer from the disadvantage that they cannot be easily and quickly reversed."*

As a matter of fact, rapid reversing is one of the very excellent features of the modern marine Diesel-engine, the average time of the leading makes in actual maritime service being between four and ten seconds, which affords excellent maneuvering for the ship, especially a twin-screw vessel.

GERMANY AND DIESEL ENGINES

We are not surprised to learn that the foolish Allied decision ordering no further Diesel-engine construction in Germany has been abandoned, nor are we surprised to learn that Germnay refuses to destroy all existing marine and stationary Diesel engines, which are valued at 1,500,000,000 marks, and the importance of which in industrial re-construction has been enhanced by the coal famine. Article 198 of the Treaty of Versailles clearly states that machinery from German warships may be used for industrial purposes, and obviously this includes the Diesel-engines of submarines.

MAIDEN VOYAGE OF 10,500 TONS MOTORSHIP "GLENTARA"

Distance Covered	24,024 nautical-miles
Running Time	96 days, 7 hrs., 3 min.
Power of Main Engines	3,600 i.h.p.
Fuel Used Most of Voyage	Borneo Oil of 0.93 s.g.
Fuel Used Part of Time	0.91 s.g.
	(14% asphaltum and 2% sulphur)
Bunker Capacity	830 tons
Total Daily Fuel Consumption	11.8 tons
Average Speed Maintained	10.4 knots
Total Lubriacting-oil Used, Main Engines	40 bbls.
Net Cargo-capacity of Holds	9,600 tons
	(Excluding fuel water and stores)

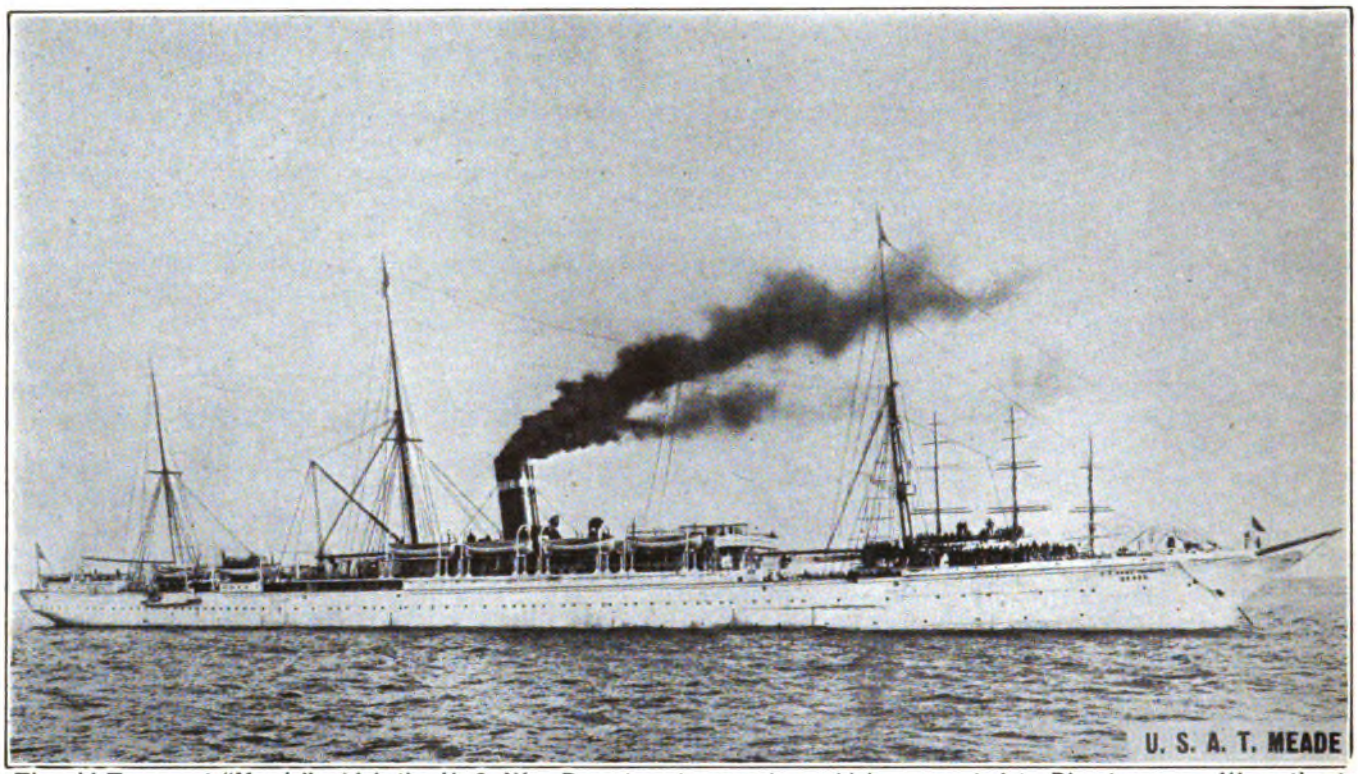
The above vessel is owned by the Glen Line of London. We suggest that American shipowners take one of their oil-fired or coal-burning steamships of similar d.w.c., compare her performance and then figure out how they anticipate competing against such an economical ship! The "Glentara" dimensions are: length, B.P., 406 ft.; breadth, 54 ft. 2 in., and 23 ft. 5 in. draught.

Generated on 2024-09-13 14:34 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Converting the Transport "Meade" to Diesel Power

U. S. War Department Steamer Could Be Re-constructed to a Motor-Tanker at Low Cost

SHIPOWNERS doubtless are aware that the U. S. War Department is disposing of a number of transports which were used during the war, but some of which now require very thorough overhauling and others which only need slight alterations. In the case of the transport "Meade" a vessel of 12,425 tons displacement, originally known as the "City of Berlin," of the Inman Line and in her days "crack" vessel of the Atlantic, the War Department suggests that the steam engines and boilers could be removed entirely, the hull fitted with tanks and inter-bottom concrete ballast and twin-screw Diesel-engines installed. The result would be a motor-tanker which would be very difficult to duplicate for the money involved for the purchase and reconstruction. Furthermore, a vessel of large carrying capacity, good speed and low operating costs would be produced.



The old Transport "Meade" which the U. S. War Department suggests could be converted to Diesel power. We estimate that as a motor-tanker she would carry about 9,000 tons of bulk-oil in addition to fuel, water and stores at a speed of 13 knots on a daily consumption of oil-fuel not exceeding 14 tons. This with a pair of 2,250 i.h.p. Diesel engines.

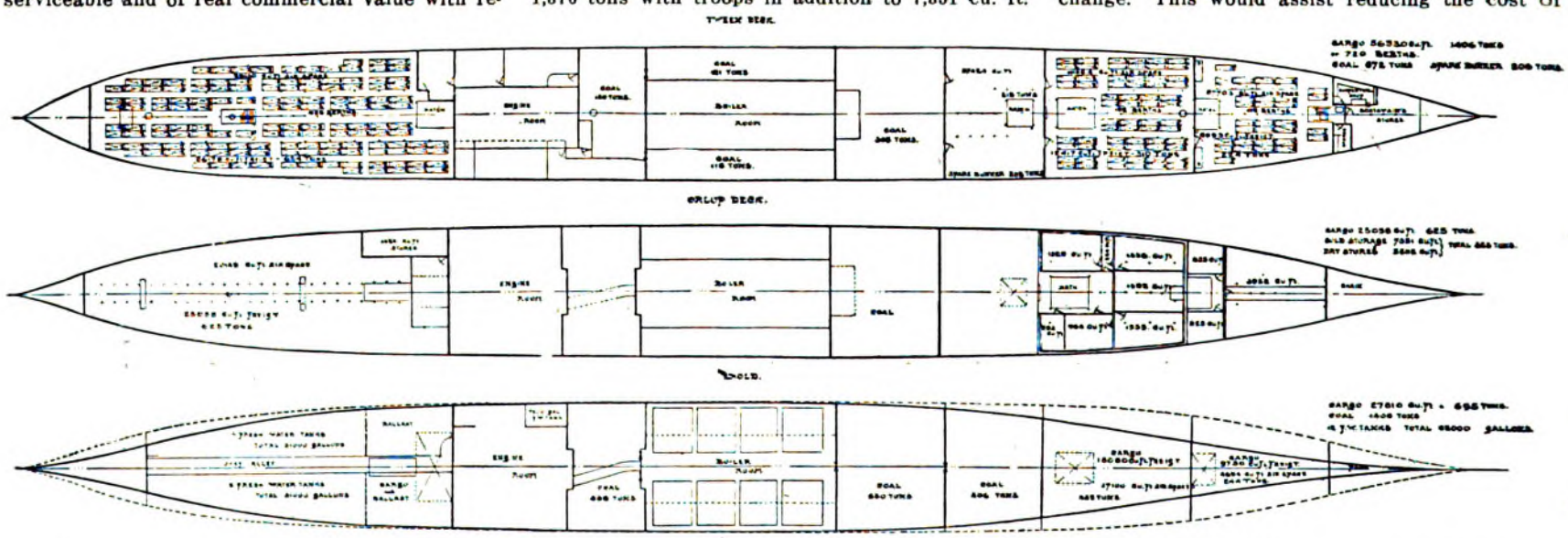
While the "Meade" at present has little value as for ocean-going work, she could be made very serviceable and of real commercial value with reconstruction at moderate cost, the hull being of the best charcoal iron. For instance, the boilers are in very poor shape, Diesel engines will make them entirely unnecessary and their room used for cargo. At present the machinery and coal bunkers occupy more than one-third of the length of the vessel in the greatest breadth of the hull; but the fitting of Diesel-engines and side oil bunkers would make a tremendous difference in the amount of space required for the machinery, making her—as we have just previously stated—pacity for 3,878 tons of cargo without troops or a large capacity bulk-oil carrier. Her general dimensions are as follows:

Displacement	12,425 tons
Length on Deck	523 ft., 6 in.
Length on water-line	488 ft., 6 in.
Breadth	44 ft., 2 in.
Loaded draught	29 ft.
Light draught	22 ft.

She is of the clipper type and is rigged as a three-masted schooner. At present she has a ca-1,376 tons with troops in addition to 7,351 cu. ft. of cold storage and 7,600 cu. ft. of dry storage. She carries 88 first-class passengers and 1,175 troops. In addition there is 276 tons of water capacity in tanks.

We believe that as such a vessel will not need more than 100 tons of fresh-water for all purposes as a motorship—that these tanks if necessary could be used for carrying additional fuel-oil, or otherwise could be retained as ballast-tanks. The plans before us are not sufficiently detailed for us to work-out the exact tonnage of this vessel were she equipped with Diesel-engines; but, if she was equipped with a pair of Diesel-engines each of 2,250 i.h.p. she would have a loaded-speed of at least 13 knots and should be built to carry (in addition to fuel, water and stores, etc.) at least 9,000 tons of bulk-oil cargo on a daily-consumption of oil-fuel not exceeding 14 tons for all purposes—the auxiliaries being, of course, Diesel electric with adequate ventilating arrangement. The engine-room for this power will be about 55 ft. long.

Incidentally, we know of Diesel-engines of this power which could be obtained in a few weeks with all auxiliaries and including cost of installation, to-day at a remarkably low figure and which are now being offered in the United States because of the great drop in the foreign money-exchange. This would assist reducing the cost of converting the "Meade." The exact amount of cargo which could be carried would, of course, have to be worked-out by naval-architects or shipbuilders, our figure of 9,000 tons being an approximate estimate and it may be more or less than this amount. As an alternative she should make an economical passenger-freighter motorship.



Plans of the transport "Meade." Note the present large engine room space. If fitted with Diesel power, a length of 55 feet would be sufficient.

Generated on 2024-09-13 14:38 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Present Position of the Marine Diesel-Engine

By JAMES RICHARDSON, B.Sc.,

of Wm. Beardmore & Co., Ltd., Dalmuir, Scotland

AS a result of the war, considerable gaps are to be found in the technical progress of many peaceful pursuits, and these must be bridged. During the years 1914 to 1918, considerations in connection with the development and applications of the Diesel engine for mercantile purposes were almost completely shelved. The exigencies of this period of stress and danger necessitated concentration on that type of machinery—the triple-expansion steam-engine—most capable of being easily and rapidly produced by those manufacturing plants less suited to the duty of meeting the requirements of the fighting forces.

In reopening the subject of the marine Diesel engine, after its absence from the proceedings of the Institution for seven years, I propose to confine my remarks solely to the broader issues, in view of the fact that at the moment so many Shipowners, Builders and Engineers are considering this new prime-mover chiefly in its general aspects.

Conditions operating at present, resulting in large measure from the war make most potent the claims advanced in favor of the principle of internal combustion. Quite suddenly and recently for the mercantile marine, fuel-oil has been very widely recognized as the most suitable combustible. Not the least compelling factors towards this marked preference have been the labor and wages movements ashore and afloat. Some fears are entertained regarding supply and distributions of liquid-fuel, but with transporting tonnage increasing and the likely early development of petrol (gasoline) substitutes, supply should continue to equal demand. Whether grounds may be found upon which to base such fears, all must be agreed as to the fundamental necessity of conserving available supplies by the exercise of the maximum economy. The effect of the operation during the war of strict discipline in national interests has rendered easier the acceptance of the doctrines of economy whatever the direction in which they are urged, and has made even the most retrogressive of men receptive of suggestions to this end.

Recent experience with the most modern and economical of steam installations applicable to merchantmen of average speed,—the steam-turbine with double-reduction gearing—has demonstrated clearly that the step from single to double reduction is not one of mere multiplication. New factors have been introduced and different values must be given to the various forces in operation. A complete solution, whether dependent upon a combination of all or principally upon a few of the many variables will no doubt early be found. The large number of factors entering into this question is sufficient alone to suggest its nature. The most important of these are lubrication, alignment of shafts, coincidence of helical angles, material and design of inter-meshing teeth, pressure and rubbing velocity between teeth, torsional vibrations, all of which play their parts. *The present position, however, is such as to give to the Diesel-engine a greater prominence than it might otherwise have achieved,* in spite of the somewhat retrograde step from purely rotary to reciprocating motion.

The past record of the oil-engine at sea shows in a striking manner the relative success of the 4-cycle principle applied to single-acting engines. Table 1 of representative Diesel motorships serves only to indicate a few of the notable vessels which have been produced. A number of these have, unfortunately, been lost during the war. Whilst out of the twenty-four, one-half are fitted with 2-cycle engines, these are in mostly isolated cases. The 4-cycle engined ships, included are generally more than usually interesting units of fleets of considerable size and importance; of one type of 4-cycle slow-running engine alone 122,000 i.h.p. are at sea.

In using the figures taken from publications as given in this table, and in subsequent data, it must be emphasized that the majority of the engines are rated at powers higher than can be consistently and continuously sustained at sea and particularly is this qualification necessary when considering the figures relating to 2-cycle machinery.

Experience during the war with submarines also showed the 4-cycle engine in favorable light. Where reduction of weight, compactness, maximum-power-per-unit-volume of ship occupied by internal-combustion machinery were the chief considerations, the 4-cycle principle was found fully to meet the requirements. In Germany the two-cycle engine was most favored for marine work prior to 1914, but for submarine propulsion during the war this system was gradually dropped, ultimately by far the largest number of the German submarines and all having the highest power per unit had 4-cycle engines. In the British Navy the 4-cycle principle was almost exclusively adhered to. Table 2 gives some of the leading characteristics of high-powered submarine engines.

The present position reflects clearly the finding of past performance and an analysis of the marine Diesel machinery under construction in all engineering countries is given in Appendix 1. Eighty-four per cent of the ships are twin-screw and over eighty per cent of the total number of marine engines and horse-power operate on the four-stroke cycle. In Britain the two-cycle is more favored than elsewhere.

The most important of the problems of design are common to both two and four-cycle engines and the first concerns the injection of the fuel into the working-cylinder. The exact quantity of fuel at a pressure sufficient to ensure injection must be measured out by the pump and spread in some 30 degrees of revolution as widely as possible into the combustion space, in a sufficiently finely divided state to ensure rapid ignition and satisfactory combustion. Chiefly in this direction of improving distribution of the fuel in the combustion-chamber can increased economy be sought.

There are two alternative methods of spraying one by means of compressed-air, the other by injecting the fuel at a high-pressure without air, known as the solid-injection system. The utilization of compressed-air is most general. So far as marine installations are concerned, the principle advantage of the solid-injection method where compressed-air is not used to assist injection, is, that the air-compressing machinery required for supplying manoeuvring power, is not a part of the main propelling-engine and does not require to run continuously at sea. Moreover, the air-compressing plant—where solid-injection is adopted—can be reduced by 40 to 50 per cent in capacity.

Reliability with air-compressors delivering at 850 to 1,000 lbs. per square-inch has now reached a high level, the leading factors towards this end being generally appreciated, and air-compressor problems rated at their full value. Multistaging is essential, and compression to 1,000 lbs. per square-inch should not be carried out in less than three stages, so proportioned that no undue ratio compression and consequent temperature can occur in any stage. Particularly should the L.P. compression be minimized. Such rises of temperature as are inevitable with compression should be reduced by efficient cooling of the air during compression and by the installation of intercoolers and after-coolers to reduce, to atmospheric whatever temperature remains after compression. Removal of moisture from the air should be facilitated. Every effort in design should be made to ensure that the compressor valves and springs are easily removed and replaced.

It is not to be inferred in any way that finality has been reached in compressor design or in methods of injection. In regard to the former a better method for removing oil and moisture from the air is required, and in respect of injection a suitable valve should be produced which, whilst requiring compressed-air spray for full power and maximum efficiency, can still operate satisfactorily at reduced power without the medium or assistance of compressed-air.

The other fundamental of injection, the measuring of the oil-fuel, involves the most delicate apparatus associated with the Diesel engine—the fuel-injection pumps and controlling-gear. The system of having one pump per cylinder is now almost universal for marine work (excepting where solid-injection is used) and only in this way can the maximum security against a large percentage of overcharge and overload in one or more of the cylinders be obtained. These individual pumps, therefore, become of relatively small size. Even with separate pumps, continual care and intelligent supervision must be exercised to ensure that the deliveries from the pumps are maintained equal, lest one or more cylinders should be overloaded to counteract the affect of diminished deliveries from defectively-working pumps. Means are now generally provided whereby any pump can be cut-out and overhauled whilst the remainder are in operation.

The Diesel engine remains a heavy and expensive prime mover in comparison with its steam rivals. Even with the progress made in design within the last six years, it can definitely be stated that there has been generally an increase in the weight and the space occupied by the slow-speed Diesel engine per horse-power developed continuously. The factors opposed to a reduction of these disabilities and rendering difficult the path towards the higher powers now desired, are the temperature gradient through the metal surrounding the combustion-chamber and the fact that the major portion of the material of the engine is only utilized for a small fraction of the running time. The former refers particularly to the two-cycle, and the latter to the four-cycle where three-quarters of the running time is idle so far as power output is concerned. Moreover, of the one power-stroke per two revolutions only one-half or 12.5 per cent of the cycle stresses the parts of the engine comparably with their strength and scantlings.

The unique economies possible by the adoption of the principle of internal-combustion are only gained at the expense of foregoing all the many advantages derived from using the most flexible known power conveying medium—steam.

To appreciate the type of stressing to which the main parts of a Diesel engine are subject, comparison may be made with a steam-engine of normal design and of equal power output. The maximum normal load with the oil-engine is more than five times as great and, furthermore, the rate of application of this main load is increased ten times.* With internal-combustion the normal stresses are liable to sudden increases calling for a larger factor of safety, and design questions relating to the main parts of the engine must be considered strictly in this light.

In regard to the temperature gradient and the stresses so incurred, data are lacking; but so far as they are available, they go definitely to prove that the 4-stroke cycle engine has distinct advantages. In Appendix 2 calculations are given to show that the temperature gradient through the metal of a four-cycle cylinder-liner and through the furnace of a cylindrical marine boiler are substantially equal. In the former the stressing is intermittent and in the latter relatively steady. The stresses consequent upon this temperature gradient are half as high again in the case of the boiler furnace due to the higher coefficient of expansion and modulus of elasticity of steel, as compared with cast iron.

With the cylinder-liner the transmission of heat is a subsidiary function to the more important duties of guiding the power piston and maintaining a suitable surface to permit of piston-ring gas tightness with minimum friction. The simple liner form of construction adopted up to the present with all but a few exceptions, cannot be approved on theoretical grounds. To obtain a minimum value for the combined stress consequent upon temperature gradient through the metal and internal pressure, a ribbed and built-up form of construction must be adopted. This can very simply be accomplished, as is sometimes the case, with the two-cycle engine, but imposes greater difficulties in the case of the two-cycle where exhaust and scavenging ports have to be accommodated in the cylinder.

Computation of the high stresses with the two-cycle cylinder in way of the scavenging-air inlet and main exhaust-ports is extremely difficult. These are bound to be very considerable in view of the high velocity of the exhaust-gases and the consequent high rate of heat-transmission from these gases to the walls, and are further intensified by the cooling and distorting effect of the entering scavenging-air with the normal two-cycle design.

For a better utilization of materials than is achieved with the four-cycle engine the two-cycle single-acting, the four-cycle double-acting, the opposed-piston construction and the two-cycle double-acting principles, or the combined effect of oil and steam as with the "Still" engine are put forward. However attractive may be the mechanical arrangements so facilitated, the Diesel oil-engine is a complicated machine highly loaded and stressed by high-pressure combustion within the cylinder, and short cuts to achieve reduction in space, weight and cost, will only be fruitful in so far as first principles and fundamentals more especially in respect of rate of heat transmissions are not violatetd.

The foregoing conditions of design of the Diesel engine prevent it being a cheap and light prime mover. Increased experience, better materials,

*(See the Proceedings of the Junior Institution of Engineers, May, 1914. "High Power Diesel engines; their development for marine service").

Generated on 2024-09-13 14:34 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Generated on 2024-09-13 14:35 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

TABLE I
NOTABLE DIESEL SHIPS

DATE	NAME OF VESSEL	DIMENSIONS			MAKERS OF MACHINERY	TYPE OF ENGINE	SINGLE OR TWIN	CYCLE	I.H.P. PER ENGINE	B.H.P. PER ENGINE	Nº OF CYLS PER ENG.	B.H.P. PER CYLINDER	DIA. OF CYLINDERS INS	STROKE INS	RATIO STROKE / BORE	R.P.M.	PISTON SPEED FT PER MIN	MEP ON B.H.P. BASIS	MIP ON I.H.P BASIS
1910	VULCANUS	1900 DIS.	208 LEN.	37¾ BEAM 13' DFT.	WERKSPOOR	WERKSPOOR	SINGLE	4 S.A.	490	390	6	65	15¾	23⅝	1·5	140	550	79	99
1912	SELANDIA	10,000 DIS.	386	53	30	BURMEISTER & WAIN	BURMEISTER & WAIN	TWIN	4 S.A.	1250	1050	8	130	20⅞	28¾	1·38	140	670	75	89·8
1912	JUTLANDIA	10,000 DIS.	386	53	30	BARCLAY CURLE	DO	TWIN	4 S.A.	1250	1050	8	130	20⅞	28¾	1·38	140	670	75	89·8
1912	MONTE PENEDO	6500 DIS.	350	50	27	SULZER	SULZER	TWIN	2 S.A.	1200	850	4	212	18½	26¼	1·44	160	715	73	103
1912	JUNO	4300 DIS	258	45	28	WERKSPOOR	WERKSPOOR	SINGLE	4 S.A.	1460	1100	6	183	21⅛	39⅜	1·87	125	820	84	111
1913	SIAM	13,200 DIS	410	55	30½	BURMEISTER & WAIN	BURMEISTER & WAIN	TWIN	4 S.A.	1580	1350	8	169	23⅝	31⅝	1 34	125	660	77	90
1913	WOTAN	7960 DWC	404	52½	29½	REIHERSTIEG	CARELS	SINGLE	2 S.A.	2100	1650	6	275	23⅝	43¼	1 83	90	650	64	81·5
1913	HAGEN & LOKI	7900 DWC	400	53	32¼	KRUPP	KRUPP	TWIN	2 S.A.	1600	1200	6	200	18⅞	31⅞	1 69	135	720	66	88
1913	ARUM	5600 DIS	380	47	27	SWAN HUNTER	SWAN HUNTER NEPTUNE TYPE	TWIN	2 S.A.	850	690	4	150	17¼ *	33	1 91	120	660	64	90·5
1914	FIONIA	7000 DWC	395	53	30	BURMEISTER & WAIN	BURMEISTER & WAIN	TWIN	4 S.A.	2140	1600	6	266	29⅛	43¼	1·49	100	720	74	99
1916	ABELIA	5600 DIS	360	47	27	WALLSEND SLIPWAY & ENGNG CO.	MASCHINEN-FIBRIK ETC (M.A.N.)	TWIN	2 S.A.	850	600	4	150	17¼	33	1·91	120	660	64	90·5
1916	TREFOIL	4510 DIS	280	39	23½	VICKERS	VICKERS	TWIN	4 S.A.	1000	750	8	94	17	27	1 59	150	675	81	108
1916	HAMLET	10050 DIS	360	56	29⅜	ATLAS DIESEL SWEDEN	POLAR	TWIN	2 S.A.	2300	1650	6	275	24	36	1·5	120	720	67	93·5
1918	ANSALDO SAN GIORGIO I	8100 DWC	378	50⅔	30½	ANSALDO SAN GIORGIO	F.I.A.T (NOW ANSALDO SAN GIORGIO)	TWIN	2 S.A.	1450	1100	4	275	24¾	35½	1·43	100	590	64	84·5
1919	GLENAPP	19000 DIS	450	55⅔	36½	HARLAND & WOLFF	BURMEISTER & WAIN	TWIN	4 S.A.	3200	2625	8	328	30	43½	1·44	115	830	74	90·5
1920	AFRIKA	18600 DIS	445	60	42	BURMEISTER & WAIN	DO	TWIN	4 S.A.	2250	1700 *	6	283	29⅛	45¼	1·55	115	865	65	86
1920	GLENOGLE	19000 DIS	502	62	27½	HARLAND & WOLFF	BURMEISTER & WAIN	TWIN	4 S.A.	3200	2625	8	328	29⅛	45¼	1·55	115	865	75	91·5
1920	FRITZ	9000 DWC	331	44⅔	—	BLOHM & VOSS	M.A.N.	TWIN	2 D.A.	1250 *	850	3	283	18⅞	28	1·48	110	515	65	95·5
1920	MAUMEE	15000 DIS	455	56	26	NEW YORK NAVAL YARD	M.A.N.	TWIN	2 S.A.	3200	2500	6	416	25⅛	37⅜	1·48	130	810	69	88
1920	CUBORE	17000 DIS	450	57	37	BETHLEHAM STEEL CO.	—	SINGLE	2 S.A.	3900	2700	6	450	25½	48	1·87	100	800	73	105
1920	ZOPPOT	22,000 DIS	525¾	66½	33½	KRUPP	KRUPP	TWIN	2 S.A.	2000	1400	6	233	22⅝	39⅜	1·73	106	695	55	79
1920	SALERNO	6500 DWC	375	51	34	WERKSPOOR	WERKSPOOR	TWIN	4 S.A.	1400	1050	6	175	22	39⅜	1·78	125	820	74	98·5
1920	NARRAGANSETT	14,000 DIS	425	56⅔	33	VICKERS	VICKERS	TWIN	4 S.A.	1620	1250	6	208	24½	39	1·59	118	767	76	90
1920	FULLAGAR	500 DWC	150	23¾	11½	CAMMELL LAIRD	FULLAGAR	SINGLE	2 O.P.	660 *	500	4	125	14	20X2	1·43	110	367	73·5	92

Eleven different designs of Diesel Engines are represented in the above list.

* APPROXIMATE

S.A. = SINGLE ACTING
D.A = DOUBLE ACTING
O.P. = OPPOSED PISTON

TABLE II
SUBMARINE ENGINES

MAKERS OF ENGINE	TWO OR FOUR CYCLE	B.H.P. PER ENGINE	Nº OF CYLINDERS	B.H.P. PER CYLR	DIA OF CYLINDER INS	STROKE INS	RATIO BORE STROKE	R.P.M.	PISTON SPEED FT PER MIN.	MEP. ON BHP BASIS
VICKERS	4 SINGLE ACTING	1200	12	100	14½	15	1 035	380	950	84
SCHNEIDER	2 " "	1600	8	200	16⅛	17¾	1·1	330	975	67
KRUPP	2 " "	1600	6	266	—	—	—	350	—	—
MAN	4 " "	1750	6	290	20·8	20·8	1	380	1315	85
MAN	4 " "	3000	10	300	20·8	20·8	1	390	1350	86
TOSI	4 " "	1500	8	188	18½	23⅝	1·27	300	1180	79

TABLE III
EXPERIMENTAL ENGINES

MAKERS OR OWNERS	TWO OR FOUR CYCLE	B.H.P PER ENGINE	Nº OF CYLINDERS	B.H.P PER CYLR	DIA OF CYLR INS	STROKE INS	RATIO BORE STROKE	R.P.M.	PISTON SPEED FT PER MIN.	MEP ON B.H.P BASIS
SULZER	2 SINGLE ACTING	1600	1	1600	39⅜ *	43⅝ *	1·1	115	1000	103
KRUPP	2 DOUBLE "	2000	1	2000	—	—	—	—	—	—
MAN.	2 DOUBLE "	6000	3	2000	31½	41⅜	1·32	160	1110	76
CARELS	2 SINGLE "	1000	1	1000	30 *	36 *	1·2	150	900	103
OXFORD	2 OPPOSED PISTON	500	1	500	19¹¹/₁₆	29½ x 2	1·49	120	590	91
STILL	2 DOUBLE ACTING	350	1	350	22	36	1·63	120	720	B/L 83 STEAM 33 } 96
ADMIRALTY	4 SINGLE "	380	1	300	20	20	1	390	1300	97

more efficient utilization of such masses as are required to cope with the pressure of the cycle, together with standardization, will in due course effect a reduction in these disabilities.

At present the cost can be stated to be from 25 to 33 per cent more than for a steam plant, depending on the type of auxiliaries applied to the oil-engined ship and whether comparison is made with steam reciprocating or double-reduction turbine steam-machinery. This higher cost of machinery is minimized in effect by the greater cargo-carrying capacity sometimes possible by the adoption of oil-engines, or alternatively by the fact that a small Diesel ship serves to give equal earning-capacity with a larger steamer. The economy of operation possible with the oil-engine is such that, granted reliable performance, the extra first cost is speedily balanced by the increased profits obtainable. Tables 4 and 5 indicate in two cases the nature of the comparison. The total saving for 200 days' sailing per annum by installing Diesel instead of steam-machinery is given for wages and keep, fuel and oil costs, in the case of a single-screw ship of 1,000 b.h.p. and also a ship of 2,400 b.h.p.; twin-screw in the case of Diesel engines and single-screw in the case of steam. *No estimation has been made regarding the other savings generally possible, the most important of which is additional cargo-capacity,* no stand-by losses and higher average speed, more particularly when the oil is compared with the coal-fired ships. The figures, however, for the savings in fuel, lubricating-oil, wages and keep are, it will be admitted, sufficiently attractive to merit close attention by shipowners to the Diesel

Digitized by Google
Original from UNIVERSITY OF MICHIGAN

system of propulsion when full comparisons can be readily made to meet the specific case of any particular type of ship or trade.

The prices of oil-fuel and coal at various ports on July 20 given in Table 6 may be referred to. (We have deleted this because of many recent price changes.—Editor.)

That after 10 years of experience keeping in view the last five years of intensive service, reliability can be obtained with the Diesel engine will not be gainsaid. The position of this new prime-mover is not yet, however, sufficiently secure for short cuts towards the lightening or cheapening of the engine to be undertaken without the most careful consideration. The available knowledge demands that oil-engines shall be rated at a moderate power output per unit of swept cylinder-volume with the consequent low-temperature gradient through and stresses in the metal exposed to combustion temperature. Ample strength and rigidity must be given to those parts that are stressed by the pressure of the cycle, and a high quality of workmanship is essential for all the principal units. So long as labor conditions do not very appreciably change the Diesel oil-engine will increase rapidly in importance with the full realization of the enormous advantages of liquid-fuel as a marine combustible. Satisfactory distribution of fuel throughout the world seems assured and *any future shortage will first affect those plants less able to compete in regard to economy* of consumption of liquid-fuel. Powers up to 6,000 or even 8,000 b.h.p. per ship with twin-screws (500 b.h.p. per cylinder) can be looked for in the near future and gradual increases will take place successfully by short steps consolidating each advance as gained before proceeding to the attainment of higher outputs.

Table 3 gives a few particulars of the largest single unit experimental engines built up-to-date. Below 800 to 1,000 b.h.p. per cylinder it can now definitely be stated that there are no limiting conditions. With increasing size of cylinder, altered methods of construction will be called for to minimize the effect of temperature gradient and may even be compelled by marine requirements in order to reduce size and weight.

Under the entirely new conditions now operating it is pleasing to reflect that in Great Britain there are under construction a larger variety of types of marine oil-engines than in any other country, indicating an enterprising and progressive policy of determined trial, This is in strong contrast to the apathy with which Britishers were charged before the war. Experience in due course with these engines will go far to enable relative values to be given to various systems and types of construction. A few may be eliminated as has been the case with other prime-movers, but the majority will remain until gradual development and increased application enables a higher plane of performance to be reached, when the issue will become narrowed down.

In the future the claims of the Diesel-electric system of propulsion will receive much more attention than hitherto, and this may prove the most secure path towards high power. Whatever the merits of steam-electric marine installations, the case for the Diesel-electric, so far as the mercantile marine is concerned, is much stronger.

The longed for internal-combustion turbine does not yet appear on the horizon. The relative inefficiency of high-pressure compressors, the losses consequent upon the transference of the working medium from the compressor to the turbine, and the difficulties experienced with available materials when subjected continuously to the high temperatures necessary for economy have so far been insuperable barriers to development.

What the future holds in store cannot be forecasted. Sufficient for the moment is the fact that there are many known problems with internal-combustion engines to which only at best comparatively clumsy solutions have so far been found. Improvement of the present state of this science calls for the highest efforts of engineering skill, and the time has arrived when energy and enterprise expended in such a direction may look expectantly for the just reward of a broadening application to marine work.

APPENDIX 1

An analysis of marine Diesel installations under construction at September, 1920.

The following figures are based on the published particulars of 184 ships and their machinery.

1. The total tonage expressed as deadweight capacity is:

1,263,000 tons divided as follows:

4-cycle=1,055,000	T.S.	1,055,000	tons deadweight
	S.S.	50,000	" "
2-cycle= 208,000	T.S.	144,000	" "
	S.S.	64,000	" "

2. The total brake horse-power is 405,000, of which 326,500 is four-cycle, and 78,500 two-cycle. The indicated horse-power is in approximately the same ratio.

3. Of the 325 engines comprised in the above totals, 275 are four-cycle, and 50 are two-cycle.

4. The average b.h.p. per engine is 1,240 b.h.p., the four-cycle being 1,190, and the two-cycle 1,570. The average b.h.p. per cylinder is 210; in the case of the four-cycle 194, and the two-cycle 309.

TABLE IV
COMPARISON OF RUNNING COSTS OF DIESEL SHIPS AND STEAM SHIPS OF 1,000 B.H.P.

	Single-Screw Diesel 1000 B.H.P.	Single-Screw Double Redn. Geared-Turbine 1000 S.H.P.		Single-Screw Reciprocating Steam 1200 I. H.P.	
		Coal	Oil	Coal	Oil
Fuel (lbs. per H.P. per hour)	0.45	1.5	1.1	1.95	1.4
Consumption (Tons per day)	4.82	16.1	11.8	25.	18
Consumption (Tons per 30 days)	145	483	354	750	540
Price of Fuel (per Ton)	£11	£5	£10	£5	£10
Cost of Fuel (per 30 days)	£1,595	£2,415	£3,540	£3,750	£5,400
Lubn. Oil Consumption (gals. per day)	10	2	2	3	3
Lubn. Oil (Cost per gallon)	5/-	5/-	5/-	5/-	5/-
Lubn. Oil (Cost per 30 days)	£75	£15	£15	£22–10	£22–10
PERSONNEL					
Chief Engineer	1	1	1	1	1
Assistant Engineers	3	2	2	2	2
Greasers	3	3	3	3	3
Firemen	..	3	3	3	3
Trimmers	..	3	..	3	..
Donkeyman	1	1	1	1	1
Electrician	1	..	..	..	..
Total Eng. R. Staff	9	13	10	13	10
Total Wages (30 days)	£191	£224–10	£195	£224–10	£195
Total Keep (per 30 days at 7/- per day)	£94–10	£136–10	£105	£136–10	£105
Total Wages, Fuel, Oil & Keep for 30 days	£1,955-10	£2,791	£3,855	£4,133–10	£5,722–10
Ratio	1	1.42	1.97	2.12	2.93
Net Saving (per annum of 200 days) Sailing Diesel over Steam	..	£5,570	£12,650	£14,520	£25,250

NOTE: In addition to the above the following savings are effected. Fuelling Costs, less demurrage, additional Cargo-capacity, less accommodation for Engine-Room Staff, no stand-by losses, less cleaning ship, higher average speed in a sea-way, reduced fuelling appliances required etc.

TABLE V
COMPARISON OF RUNNING COSTS OF DIESEL SHIPS AND STEAM SHIPS OF 2400 B.H.P.

	Twin-Screw Diesel 2400 B.H.P.	Single-Screw Double Redn. Geared-Turbine 2400 S.H.P.		Single-Screw Reciprocating Steam 2800 I.H.P.	
		Coal	Oil	Coal	Oil
Fuel (lbs. per H.P. per hour)	0.45	1.5	1.1	1.75	1.25
Consumption (Tons per day)	11.6	38.6	28.3	52.5	37.5
Consumption (Tons per 30 days)	348	1158	849	1575	1125
Price of Fuel (per Ton)	£11	£5	£10	£5	£10
Cost of Fuel (per 30 days)	£3,828	£5,790	£8,490	£7,875	£11,250
Lubn. Oil Consumption (gals. per day)	21	3	3	5	5
Lubn. Oil (Cost per gallon)	5/-	5/-	5/-	5/-	5/-
Lubn. Oil (Cost per 30 days)	£157–10	£22–10	£22–10	£37–10	£37–10
PERSONNEL					
Chief Engineer	1	1	1	1	1
Assistant Engineers	6	3	3	3	3
Greasers	3	3	3	3	3
Firemen	..	9	6	9	6
Trimmers	..	4	..	4	..
Donkeyman	1	1	1	1	1
Electrician	1	..	..	..	..
Total Eng. R. Staff	12	21	14	21	14
Total Wages (380 days)	£252–10	£380–10	£265	£380–10	£265
Total Keep (per 30 days at 7/- per day)	£126	£220–10	£147	£220–10	£147
Total Wages, Fuel, Oil & Keep for 30 days	£4,364	£6,413–10	£8,924–10	£8,513–10	£11,699–10
Ratio	1	1.47	2.04	1.95	2.68
Net Saving (per Annum of 200 days) Sailing Diesel over Steam	....	£13,650	£30,390	£27,645	£48,850

NOTE: In addition to the above the following savings are effected. Fuelling Costs, less demurrage, additional Cargo-capacity, less accommodation for Engine-Room Staff, no stand-by losses, less cleaning ship, higher average-speed in a sea-way, reduced feulling appliances required etc.

APPENDIX 2

Comparison of the Temperature Gradient and Stress in a Cylindrical Boiler Furnace and a Diesel Engine Cylindrical Liner

Estimation of the temperature drop through the metal of a cylindrical boiler furnace.

Assume an evaporation from the furnace crown of 15 lbs. of water per hour per square foot of heating surface.

The number of B.T.U.'s required to raise 1 lb. of water from a feed temperature of 191° F. to 391° F. (temperature for a pressure of 200 lbs. per square inch).

The total B.T.U.'s = 200+839=1,039.

B.T.U.'s per square foot of furnace 1039×15=15,600 B.T.U.'s per square foot.

The temperature drop to convey this heat flow through a furnace shell of ⅝ inch thickness is

$T_1 - T_2 = \frac{Q \times t}{K}$ where t is thickness in feet, and K is conductivity of the steel plate.

$$T_1 - T_2 = 15600 \times \frac{.625}{12 \times 26} = 31° \text{ F.}$$

This is equivalent to approximately 50° F. drop per inch thickness, and a resulting stress of slightly above 3,000 lbs. per square inch.

To examine the case of the Diesel-engine cylinder-liner.

Assuming that 10 per cent of the heat of the fuel passes through the cylinder-liner and that the ratio of maximum to mean heat flow is 2.5 to 1 with a consumption of 0.425 lbs. per b.h.p. per hour, the heat flow becomes

$$\frac{10}{0.425 \times 18{,}000 \times 100 \times 2.5} = 1{,}920 \text{ B.T.U's per b.h.p. per hour.}$$

With an average piston-speed a fair allowance of liner surface exposed to the combustion-gases per b.h.p. is 9 sq. feet. Using the same equation as above and considering a liner of 1 inch thickness. $T_1 - T_2 = \frac{Q \times t}{K} = \frac{1920 \times 9 \times 1/12}{26} = 55°$ F. per inch thickness and a stress of about 2,000 lbs. per square inch.

AUXILIARY SCHOONER "KIRKETIND"

The auxiliary schooner "Kirketind" has been sold in the Federal Court, Seattle, to the Donovan Steamship Company for $153,000.

STILL-ENGINED TRAWLER

Now under construction at Nantes, France, is the motor-trawler "La Francaise" for service off the coast of Spain and Morocco. She is of special interest as she will be propelled by a Still combination steam-and-Diesel engine.

Generated on 2024-09-13 14:39 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Air-Injection or Mechanical-Injection

A Technical Treatise of a Subject of Great Importance to Diesel-Engine Builders

By J. L. CHALONER

THE Diesel-engine of to-day is in principle the Diesel-engine of twenty years ago, but its commercial application, however, stands in no direct relation to that of even six years ago. The high-pressure oil-engine of to-day is the low-pressure oil engine of twenty years ago. Its commercial importance was not even considered six years ago.

Without examining the various factors, which define the technical difference between these two types, and their relative importance to marine engineering, it is yet an established fact that the present position of the marine oil-engine has to a very great extent been reached by the stimulus of war. One might even go so far as to state that the war period has been the critical moment in the development of this type of prime mover.

The progress in 1914 was sufficient to justify not only its utilization as a propelling agent of war machinery, but also a consideration of its possibilities as a marine engine. As a result of its proved utility, the progress has been beyond the highest expectations of even the enthusiast and advocate of the oil-engine, and the observer must naturally ask the question:

What is the cause of this abnormal development?

Whatever may be the features of the Diesel principle, whatever may be the commercial advantages

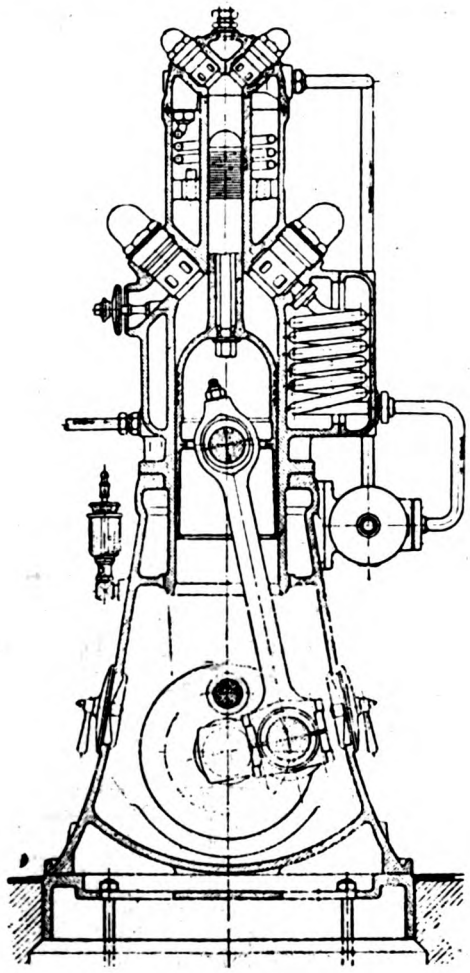


Fig. 1

of the application of the oil-engine, whatever may be the change in the economic position of any country as a direct consequence of such development, they are factors which must give way to the governing influence, which the human factor has exercised on the main issue:

Steam Versus Oil

To-day the marine engineer has taken kindly to the oil-engine. For five years a large body of marine engineers has been brought in close contact with the oil-engine under practical conditions. Their training as engineers has permitted them to forget for the time any prejudice which they might or might not have had for oil-engines. As was to be expected, views have been modified, converts have been made, and with it the prospect of the marine oil-engine has been enhanced to an unmistakable extent.

Whereas the engine builder or designer was formerly up against the marine engineer at every point under dispute, the genuine co-operation of the man who has got to run the job, and in whose hands lie the success or the failure of this type of engine, is now assured. But one can even go one step further. The initial success of the Diesel-engine was as a land type, and it was in a good many instances the stationary-engine builder who adapted his engine for marine purposes. Such policy, although quite conventional, laid the Diesel-engine builder open to criticism on the many points which were obviously impracticable from a marine engineer's standpoint. I have come in contact personally with marine engineers, brought

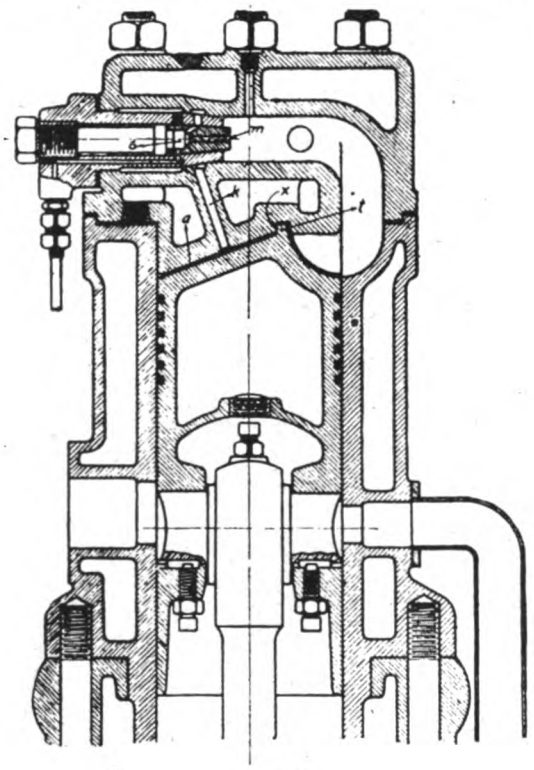


Fig. 2

up on steam, who after a stay of 48 hours aboard a motor-vessel, would draw up pages on the suggested improvements which they considered essential. Their lack of confidence in anything screened behind cast-iron walls, and which in face of former experience, could have remained visible, was undoubtedly responsible for most of the suggestions offered, but this story brings out very clearly the fallacy of conversion as against reconstruction.

Even to-day the designer has not the marine-engineer with him in the sense that he would like, but the marine-engineer exercises a progressive influence on the engine. The marine-engineer is now interested, and he will automatically utilize

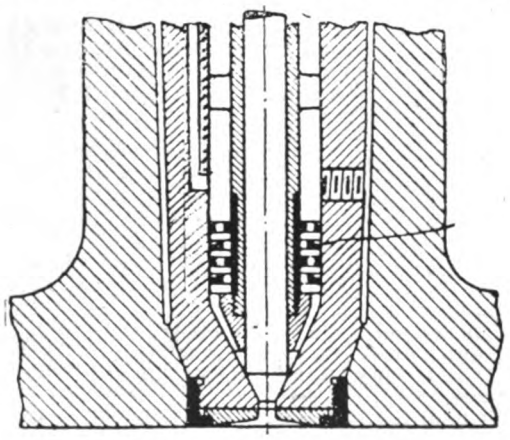


Fig. 3

his steam-engine experience to make the oil-engine equally simple and reliable.

A healthy competition is springing up between the practical and technical branches, which is bound to assist materially in the development of the marine oil-engine.

Looking back for a moment, and comparing the main features of the original Diesel-engine with the modern pattern, one is struck with the similarity which is still retained. It would be beyond the scope of this discussion to deal adequately with the many points which fall under this category. There is, however, one constructional detail which affects the main point at issue, and that is the air-compressor. This main auxiliary which absorbs from 9 per cent to 16 per cent of the effective work developed in the power cylinder, is as essential to-day as it was 27 years ago.

It is not the intention to criticize the compressor from the point of view of reliability, or possible danger from explosion, nor is it denied, that compressed air will be essential, at least for a good many years to come, for most engines when starting or manoeuvering.

The whole crux of the matter, however, lies in this:

The designer should dispense with as much auxiliary gear as possible. The shipowner does not consider himself justified to provide money and valuable space for the installation of superfluous gear. The chief will prefer the plant which is the simplest to supervise.

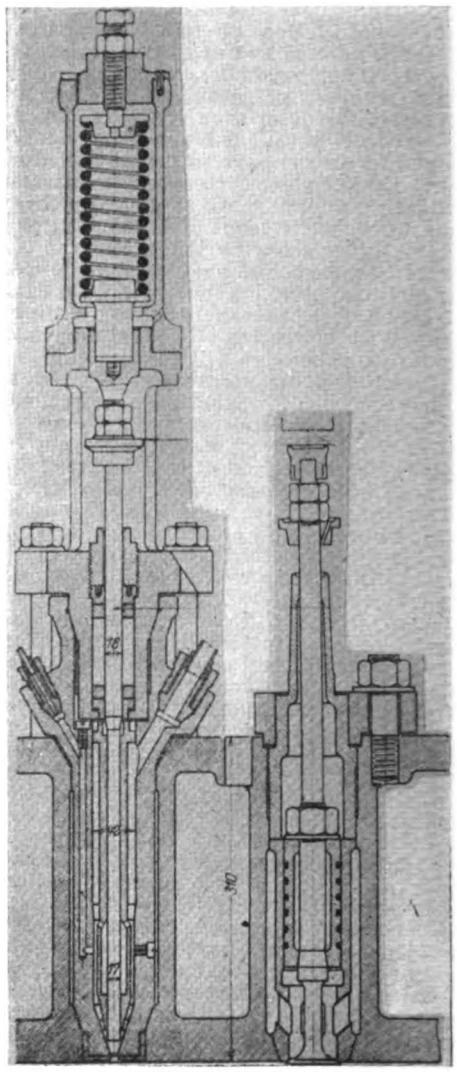


Fig. 4

I am ready to admit the mechanical perfectness of the air-compressor, but I consider it an undesirable feature of the Diesel-engine outfit.

A main auxiliary working continuously at 1,000 to 1,200 lbs. per square inch is not the same proposition as an air pump working intermittently at pressures up to 900 lbs. per square inch. Furthermore, however perfect, it requires attention, costs money both to run and to maintain. Why incur such expenditure when it can be avoided? It is possible to design to-day an oil-engine which dispenses with the air compressor, and this statement brings me to the main topic under consideration:

Air-Injection Versus Mechanical-Injection

Air-injection is defined as the method of injecting the fuel charge into the cylinder, the injection medium being compresed air, which carries the fuel from the fuel valve into the combustion chamber.

Mechanical-injection—or solid-injection, as it is more generally and perhaps incorrectly termed—is defined as that method of injecting the fuel charge into the cylinder, the injection medium being pressure under which the fuel is forced from the fuel-valve into the combustion chamber. While it is admitted that "solid-injection" is more frequently used nowadays than any other term,

Generated on 2024-09-13 14:36 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

let it be suggested that what is after all the correct technical description, i.e., "mechanical-injection," be adopted.

The nomenclature of the oil-engine has suffered greatly at the hands of the careless sales department, which has an eye on advertisement first, and ignores the value of accurate technical interpretation.

The misuse of the word cycle in such fundamental expressions as "two-stroke" and "four-stroke" engines, the obvious propaganda underlying the difference of the "Semi-Diesel" and "Diesel" engine being defined as the former, using half as much fuel as the latter, the rather crude analogy of "solid injection and solid exhaust" are sufficient instances to emphasize the fact that not too much care can be taken with the selection of appropriate descriptive titles for the various important technical and constructional details.

It is the intention to compare in this discussion the advantages and disadvantages of the two main principles of injecting the fuel into the cylinder. It will be necessary to introduce arguments which are based on theoretical and highly technical reasoning. The subject, however, is of sufficient importance not to necessitate any apology to the practical marine engineer, who will find himself on rather strange ground, compared with the technical engineer, who will undoubtedly welcome a concise and complete survey of what to-day represents one of the chief controversies in oil-engine design.

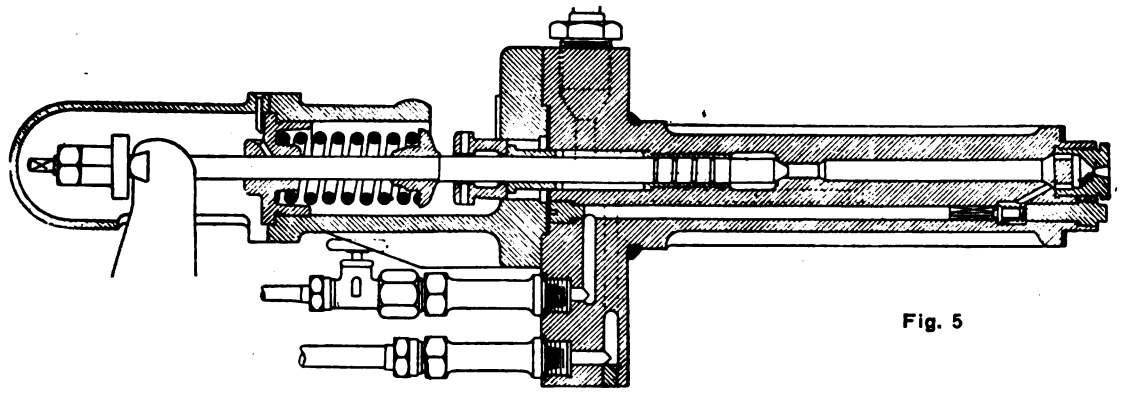


Fig. 5

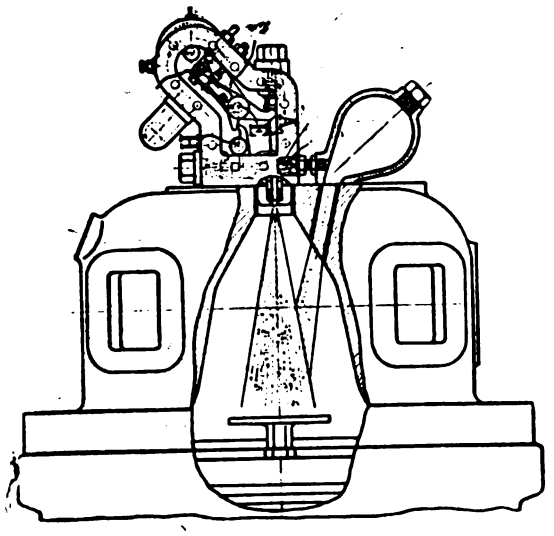


Fig. 6

Let us get familiar with the many forms of injection in vogue at the present time.

1. *Air injection.*
   - A. The high pressure engine.
     - 1. The fuel is distributed in a number of annual spaces on the "off" side of the fuel-valve, and at the correct moment is carried into the cylinder by highly compressed air, which is provided either from a compressor (Fig. 1) or is produced in the power cylinder itself (Fig. 2.)*

       The fuel-valve is constructed either in form of a ring pulverizer (Fig. 3), or a sleeve pulverizer (Fig. 4).
     - II. The fuel is fed into a reservoir, in direct communication with the combustion-chamber, i.e., on the "on" side of the fuel valve, and at the correct moment is dragged into the combustion chamber (Fig. 5).

*This method was abandoned owing to the temperature of the injection air being dangerously high.

   - B. The Surface-ignition engine.
     - I. The fuel jet is split up into a mainspray, which enters the combustion chamber proper through a mechanically-operated valve, and is met there by the auxiliary spray, also mechanically controlled but compelled to pass over a heated surface prior to meeting the main spray (Fig. 6).
     - II. The fuel jet meets a corresponding air jet at the point of entering the combustion-chamber (Fig. 7).

       The fuel really enters the cylinder under a positive pump pressure, and the air jet is said to act more as a cooling agent of the combustion-chamber in place of the antiquated method of injection water, than as an atomizing agent.
2. *Mechanical injection.*
   - A. The high pressure engine.
     - I. The fuel is injected into the cylinder under pressure, the fuel-valve opening being controlled automatically by pressure difference (Fig. 8).
     - II. The fuel is injected into the cylinder, the injection period being under mechanical control (Fig. 9).
   - B. The Surface-ignition engine.

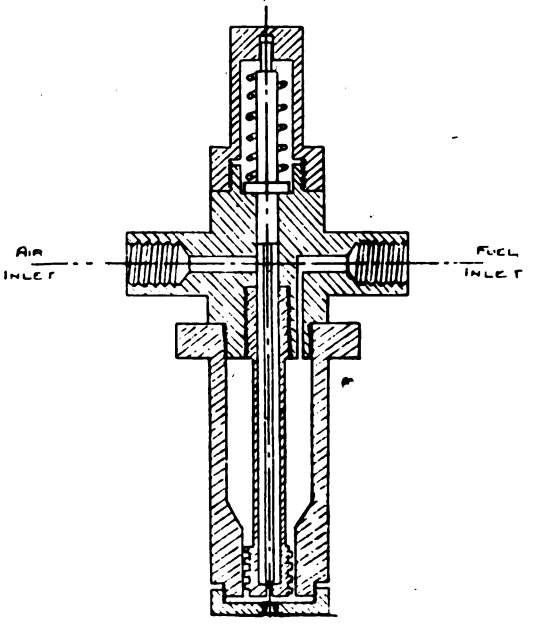


Fig. 7

     - I. The fuel is injected into the cylinder under pressure, the fuel-valve opening being controlled automatically by pressure difference (Fig. 10).
     - II. The fuel is injected over a heated surface, the fuel-pump controlling the injection period (Fig. 11).
3. *Gas-pressure injection.*
   - A. The high-pressure engine.

     There is no practical example in existence.
   - B. The Surface-ignition engine.

     The fuel is pumped into a passage, in direct communication with both the cylinder proper, and also a kind of vaporizer (Fig. 12). A portion of the charge is blown into the vaporizer by the compressed-air in the cylinder during the compression stroke, is gasified in the vaporizer, and the pressure thus created is utilized in spraying the remainder of the fuel into the combustion chamber proper.

The Thermo-dynamics of the Oil Engine

When examining indicator-cards from both air-injection and mechanical-injection engines, it will be observed that with the latter combustion takes places partially at constant volume, and partially at constant pressure, or nearly so.

It will be necessary to compare the two cycles, in order to establish some base, even if only hypothetical, whereby we are able to calculate the relative thermal efficiencies.

Fig. 13 represents the constant-pressure cycle, and we have the folowing relations:

(a) Adiabatic ($p\,v^n$) compression (1-2) giving:

$$\text{Compression ratio } (r) = \frac{VT}{VC}$$

(b) Combustion at constant pressure (2-3) giving:

$$\text{Cut-off ratio } (R) = \frac{VE}{VC}$$

(c) Adiabatic ($p\,v^n$) expansion (3-4) giving:

$$\text{Expansion ratio} = \frac{VT}{VE}$$

(d) Exhaust to atmosphere (4-1) giving:

$$\text{Pressure drop (at constant volume VT)} = \frac{P_4}{P_1}$$

As regards the thermal changes we get the following relations:

Heat supplied during cycle

$$= HS = QS\,c_p\,(T_3 - T_2) = QS\,c_p\,T_2^{(R-1)}$$

Heat abstracted during cycle

$$= HA = QA\,c_v\,(T_4 - T_1) = QA\,c_v\,T_1\,(R^n - 1)$$

But

$$\text{Efficiency} = \frac{HS - HA}{HS} = 1 - \frac{HA}{HS} = 1 - \frac{QA\,c_v\,T_1(R^n - 1)}{QS\,c_p\,T_2(R-1)}$$

Since

$$QA = K\,QS;\ c_p \div c_v = n;\ \frac{T_1}{T_2} = \frac{(VC)^{n-1}}{(VT)} = \frac{1}{r^{n-1}}$$

$$\therefore\ n = 1 - \frac{K\,(R^n - 1)}{n\,r^{n-1}\,(R-1)}$$ equals Thermal Efficiency

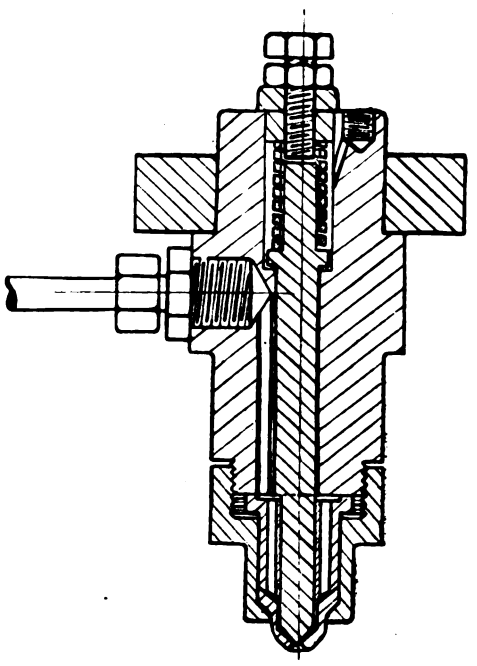


Fig. 8

K is a constant, which varies for two and four-stroke engines, and also with slow and high speed designs.

R, the cut-off ratio, affects the efficiency, in as much a minimum value of R will give a maximum efficiency.

Considering now the other cycle (Fig. 14), and retaining as far as possible the same lettering:

(*To be continued*)

THE BETHLEHEM MOTORSHIPS

The four 20,000 tons d.w.c. Diesel-driven motorships ordered by the Bethlehem Steel Co. reported in the last issue of "Motorship," will carry both ore and oil. The latter will be transported on the voyage to South America and ore on the return trip. The net capacity will be 130,000 barrels of oil, or 19,000 tons of ore.

Generated on 2024-09-13 14:38 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

British Admiralty Experiments with Diesel Engines

A Technical Article of Particular Interest to Engine Builders

By Engineer-Commander C. J. HAWKES, R. N.

Part III

(*Continued from page 998, November issue*)

Although it is not proposed to give a description of the large German submarine engines, a comparison between the weights of the piston and connecting-rod of the German engine and the Laboratory engine already referred to, of approximately the same B.H.P. per cylinder—viz. 300, may be of interest:—

Comparison between German and Admiralty Engineering Laboratory Engines.

TABLE V

Engine.	Cylinder Diameter.	Stroke.	R. P. M.	Connecting Rod, including Bottom and Top End Brasses.		Piston, complete with Pipes and Guards.	
				Total Weight.	Weight per Square Inch of Piston.	Total Weight.	Weight per Square Inch of Piston.
	In.	In.		Lbs.	Lbs.	Lbs.	Lbs.
German	20.8	20.8	380	938	2.76	945	2.78
Admiralty Engineering Laboratory	20	20	390	820	2.61	503	1.6

[A complete and illustrated description of the Augsburg (German) ten-cylinder 3000 b.h.p. four-cycle submarine engine appeared exclusively in "Motorship" of January, 1920.—Editor.]

One of the first starting diagrams taken from the 300 B.H.P. Laboratory engine is shown in Fig. 8 This diagram was taken with an indicator-gear 90 degrees out of phase with the ordinary indicator-gear. It will be seen from the diagram that when starting air was admitted into the cylinder the piston was in a position corresponding to A, and the rise of pressure is along the line A B. K C D is the compression curve, and subsequent admissions of starting air are shown by the curves 1, 2, etc. The first ignition of oil is shown by the line E F, the second ignition by G H, the third by I J. It will be noticed that as the speed of the engine increases the maximum compression pressure increases slightly, and also, omitting the first ignition, the ignition occurs later—the timing gear being kept in the same retarded position throughout.

Figs. 9, 10 and 11 are ordinary diagrams representative of those taken from the engine.

It is considered unnecessary to refer to the past history of high-speed Diesel engines, as we are principally concerned with the future. It is hoped that in the future technical opinions in regard to the process of development will be more readily accepted than they have been in the past, for *there is no doubt that in many instances progress has been arrested by the lack of success which has frequently followed the action taken as the result of the influence of the enthusiastic amateur.*

In addition to the engines already mentioned, other engines have been experimented with at the Laboratory and interesting and valuable results obtained, but it is not possible within the limits of this paper to make more than a brief reference to them.

The following engines and plant are being experimented with or are under construction, in addition to those already mentioned:—

Opposed-piston Engine.—The opposed-piston type of two-stroke engine is represented by a single-cylinder, totally enclosed engine, which was obtained from Messrs. W. Doxford & Sons Sunderland. This engine was designed by the firm as an experimental submarine unit, originally for their own use. It follows the firm's usual design, which is generally well known and need not be described here, and has a diameter of 14.55 in. and a combined stroke of 28.3 in. The double-acting scavenge pump and four-stage air compressor are driven from two cranks on an extension of the engine-shaft. This lay-out for a single-cylinder engine reduces its mechanical efficiency slightly, especially having in view the fact that the scavenge-pump and compressor were made larger than necessary for ordinary running, for the purpose of supercharging experiments at a later date.

The engine had not been run when it was delivered to the Laboratory. A large number of tests have now been carried out, and after making various modifications, particularly to the two fuel-valves, very good results have been obtained. The representative results are shown in Table VII.

Texas fuel-oil, having a specific gravity of 0.91 at 60° F., was used for all tests and the exhaust was clear throughout.

The pressure of the scavenge-air in the belt was from 2½ to 3 lbs. per square inch. The engine runs smoothly and well at all speeds. The pistons, which have steel heads and aluminium-alloy skirts, are cooled with oil.

The upper piston is fitted with thermocouples, and the results so far obtained indicate that the temperature of the metal at a point ⅛ in. from the surface of the piston, when the engine is developing about 300 B.H.P., is about 630° F. The upper piston is swept by the exhaust-gases, whereas the lower piston is swept by the comparatively cool scavenge air, and the temperature of the latter will consequently be less than the former. It was anticipated that higher temperatures would be registered, in view of the thickness of the piston top, but the above figure gives the mean result so far obtained at the power stated. Pistons of different material are now in hand and will be fitted at a later date.

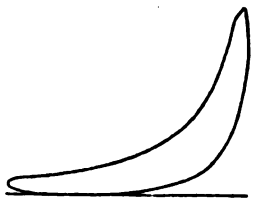


FIG. 9.

Cyl. Dia. 20 in., Stroke 20 in., R.P.M. 300, M.E.P 142·5, I.H.P. 339, B.H.P. 300, Mech. Eff. 88·5, Fuel, Texas, Comp. Press. 480.

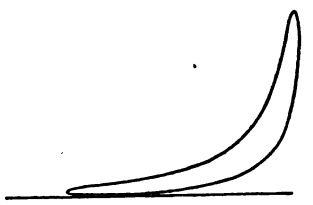


FIG. 10.

Cyl. Dia. 20 in., Stroke 20 in., R.P.M. 262, M.E.P. 99·6, I.H.P. 207, B.H.P. 173, Mech. Eff. 83·6, Fuel, Texas, Comp. Press. 475.

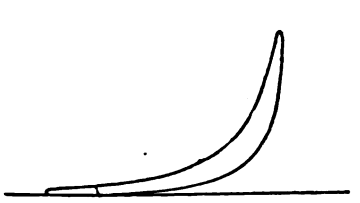


FIG. 11.

Cyl. Dia. 20 in., Stroke 20 in., R.P.M. 222, M.E.P. 76·6, I.H.P. 135, B.H.P. 106, Mech. Eff. 78·5, Fuel, Texas, Comp. Press. 475.

Test of Doxford Opposed-piston Submarine Diesel Engine.

TABLE VII

R. P. M.	I. H. P.	B. H. P.	M. E. P.	Mechanical Efficiency, Per cent.	Blast Pressure, Lbs. per Square Inch.	Temperature of Exhaust Gases, Degrees F.	Fuel per H. P.-hour. I. H. P.	Fuel per H. P.-hour. B. H. P.
322	500	333	130	66.6	1,325	700	0.32	0.48
305	436	280	126	64.2	1,225	633	0.30	0.47
286	365	230	107	63.0	1,100	573	0.29	0.47
265	308	185	98	60.0	1,000	527	0.29	0.48
240	249	141	87	56.6	900	463	0.28	0.49

Compound Internal-Combustion Engine.—The design of this engine, which was the outcome of a proposal and outline sketches submitted by Mr. H. Ricardo was commenced at the Board of Invention and subsequently completed at the Laboratory. It was constructed by Messrs. P. Brotherhood & Co. to working drawings supplied by the Laboratory. After a number of tests had been carried out, it was decided that in view of the unavoidable complication of the engine for marine purposes and the pressure of other work to discontinue the experiments for the present.

Hot-bulb Engine.—A 40-B.H.P. single-cylinder Bolinder engine has been obtained, but this will not be erected until the Laboratory is transferred to West Drayton.

30-B.H.P. Single-cylinder Four-stroke Diesel Engine.—This is being constructed principally for use in connection with the testing of fuel-oils. Delivery will be made shortly.

Kerosene Engine.—In view of the number of kerosene engines now in use in the Navy, a four-cylinder engine of about 50 B.H.P. has been obtained and tests have commenced.

Two-stroke Single-acting Engine.—A single-cylinder single-acting two-stroke engine of about 400 B. H. P. is being constructed for the Admiralty by Messrs. J. S. White & Co., Cowes. The working drawings were undertaken by the firm, the outline design and drawings of various details being provided by the Laboratory.

Two-stroke Double-acting Engine.—A preliminary design has therefore been made which may be taken up at a later date.

Small Plant.—A number of small pieces of apparatus have been designed by the Laboratory and constructed for experiments in connection with fuel-injection; the study of the fuel-spray; the ignition temperatures of fuel-oils from the engineers' standpoint; the testing of white-metal for bearings and material for piston rings, etc.

The fuel-injection problem is of the utmost importance in connection with the successful development of the high-speed marine oil-engine, and it is hoped that it will be possible at a later date to give some information on this subject.

In the discussion which followed Commander Hawkes's paper, Engineer Vice-Admiral Goodwin said, that soon after the Laboratory was established it began to supply information of great interest to engineers in the Navy in connection with Diesel engines. After experimental work had been completed in the Laboratory, and they were satisfied they could employ aluminium pistons in submarine engines, a set of these pistons was fitted. After a 300 hours' test the pistons were sent to the Laboratory for inspection, and the report on their condition was favorable. Aluminium pistons were then fitted in the whole of the cylinders of submarine engines. These engines had been in service for two years, and on the whole had given very satisfactory results. The fitting of aluminium pistons enabled the power to be increased, and the result had been in that particular class of submarine the weight of the machinery had been considerably reduced. It was the lightest engine of the type, and was the direct result of the first year's working of the Laboratory. Engineer-Commander Hawkes, in his paper, said there was no indication of growth on the aluminium alloy. Since the paper was printed a report had come to hand, and although it was not very definite, there was some indication of a growth. This point called for investigation.

Finis.

Generated on 2024-09-13 14:41 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Refrigerating Machinery for Motorships

Some Examples of American and European Equipment on Diesel-Driven Merchant Vessels

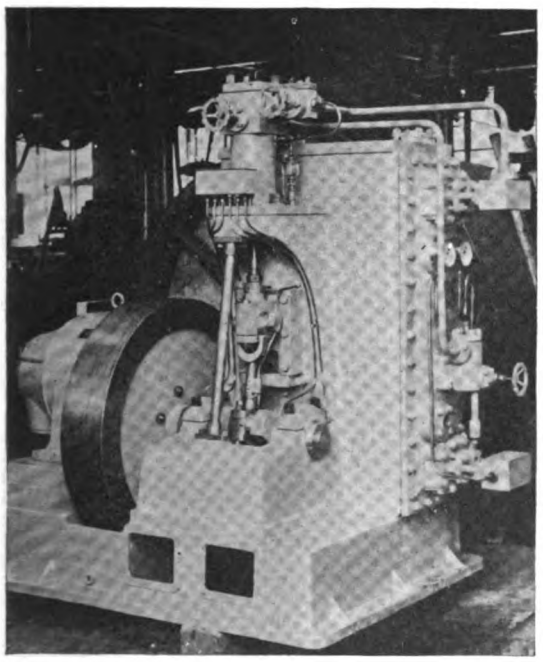
DOMESTIC manufacturers of ship's refrigerating apparatus—with a few notable exceptions—appear to have almost entirely overlooked the motorship field as an excellent existing market for their products. Yet this market is becoming more important every month, as is indicated by the fact that during the last few months practically the only dry-cargo carrying merchant-vessels ordered in the United States are five very big Diesel-driven motorships, the various steam-driven ships lately ordered being tankers for which very rapid delivery was required. Some large Diesel-driven tankers and three 11,000—12,500 tons motor freighters also one 6500 tons motor freighter are also under construction in America, and refrigerating sets are being installed on these craft. Altogether eleven large motorships aggregating 138,210 tons d.w.c. are now actually on order in the United States.

Some of the numerous motorships now building abroad will carry as many as 150 first and second-class passengers in addition to crew and cargo, and some of the American motorships under construction will carry one to two dozen passengers, while in a few cases special refrigerating-holds are provided for fruit-carrying. Moreover, three motor-ships now building in Great Britian and Denmark are specially designed to carry solely fruit, while four of the American cargo motorships on order are of 20,000 tons d.w.c.: while the latter will neither carry fruit or passengers, they will have refrigerating equipment for the food supplies for the crews.

It will readily be understood that these motorships not only need an efficient ice-making plant, but require the capacity of the equipment to be a very large one, involving the outlay of a substantial sum of money. That refrigerating equipment manufacturers have already missed some business is indicated by our own experiences. We recently made a voyage aboard an 8,000 tons motorship which is one of three sister craft. She has no ice-plant or cooling apparatus on board, but is obliged to load two tons of ice each one-way voyage for the use of the officers and crew of 45 men, and their food. The same builders—who are keen readers of "Motorship"—have now constructing a large fleet of bigger Diesel-driven motorships including six combination passenger-cargo transatlantic liners of 12,000 tons and 16-knots speed. Obviously these ships will need extensive refrigerating equipment.

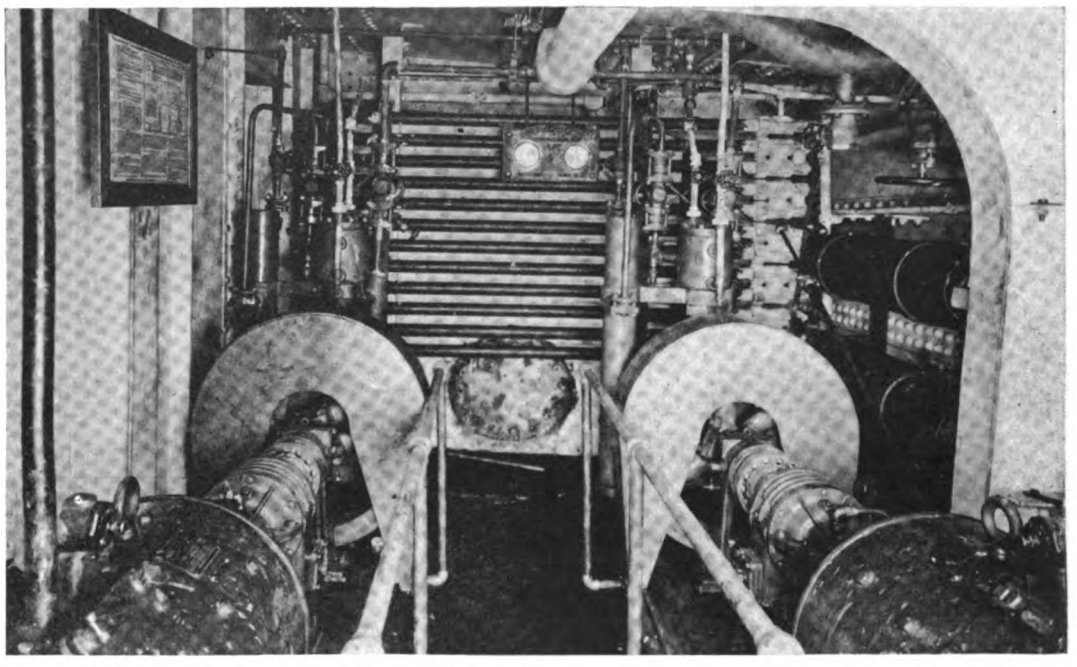
Mechanical refrigeration is becoming more generally recognized by the sea-faring man. It is served. Cold water may be provided by means of a small scuttle-butt from which either taps may be taken direct or on the larger vessels a regular water circulating system is installed. In addition to this an ice making set can be included to freeze any desired quantity of ice for either ice-tea, or mixed drinks depending on the nationality of the vessel.

Many companies have been rather slow in adopting this form of cooling because of the initial expense; but they have all found that in the end it is a very high paying investment. During the recent dock-strike in New York when it was very difficult to get near the docks with ice or other supplies, the boats with mechanical refrigeration were saved a great deal of expense and inconvenience and even during normal times, the elimination of being compelled to ice up at every port is a more decided advantage.



Electric-driven Sabroe air-compressor for motorship's ice plant

more economical than ice not only from the first cost standpoint, but because of the fact that practically no goods are ever thrown overboard. This means that the crew is better satisfied and it is easier to get a good class of men on a vessel with refrigeration than it is on one where ice is the refrigerating medium. A refrigerating plant enables a vessel to be absolutely independent of the shore as far as refrigeration is concerned. Any numbers of refrigerators may be maintained at the proper temperatures for the goods that are to be pre-



Brunswick twin refrigerating-set on the Texas Co.'s motorship "Solitaire." In the foreground can be seen the Diehl electric motors.

Refrigerant plants aboard ship are in practically every instance of the compression type and practically all of the small units employ anhydrous ammonia as the refrigerating medium. There is a further sub-division of refrigeration into the direct-expansion system and the brine circulating system; the former is employed in the smaller units where only two or three refrigerators, an ice making set and a scuttle butt located within a comparatively small area are to be taken care of. In this case, the expansion valves can be placed either at the refrigerators or they can all be located in the machine room and regulated from there. As it is only necessary to insulate the return expansion lines, there is a saving in insulation by placing the expansion valves on the refrigerators. On the other hand, many engineers prefer having the expansion-valves near the machine where they can handle them in connection with their pressure-gauge. As a matter of fact, a properly designed expansion-valve requires but very little regulation.

Among American companies who have paid special attention to the motorshipping industry may be mentioned the Brunswick Refrigerating Co., Jersey Ave., Brunswick, N. J. whose ice-machines are made under license from designs of the J. & E. Hall C.O.2 refrigerating equipment. It may be remembered that the Texas Steamship Co.'s motor tanker "Solitaire" has two of their sets, which we now illustrate.

A refrigerating plant to take care of a motorship of 12,000 tons capacity, carrying 20 passengers and a crew of 50 should have not less than two 1-ton refrigerating units to cool a meat storage refrigerator, a general storage refrigerator, and in some cases an additional general storage refrigerator, also a scuttle butt and an ice-making set. The Brunswick Refrigerating Company's compressor is of the single-acting vertical type. enclosed self-oiling, eccentric drive; the piston drawing the gas in thro' a port in its side, and discharging thro' the top of the cylinder by means of a discharge valve or lifting-head which is the full area of the cylinder. These compressors are designed so that they may be set on special bedplates with a motor or gear drive, or direct connected with a slow-speed motor, or they may be driven by a chain or standard belt. The condensing surface is figured on a basis of about 40 lineal feet of double-pipe condenser made of 1¼" and 2" pipe for a ton of refrigeration.

Every Brunswick compressor, ammonia receiver and oil interceptor is equipped with sight-gauge with safety cocks. The scuttle-butts are galvanized with a galvanized-iron coil, and the outside of the scuttle-butt is insulated with granulated cork, specal water-proof insulating paper, and ⅞ T. & G. boards. The ice-making sets are of heavy steel, well insulated with granulated cork, paper, and boards. The top is provided with a special steel cover over which is placed a full size rubber gasket covering the entire top of the tank.

The ice cans are specially flanged, setting down on this rubber gasket, then the wooden covers are clamped down on top of the cans providing a brine and water-proof fit. All direct-expansion coils in the refrigerator are extra heavy, ammonia piped, bent and electrically welded so that each coil is like one continuous piece of pipe.

A refrigerating plant aboard ship should if possible be installed in duplicate, so that should one plant for any reason be out of commission, the other plant can carry on the work. Furthermore, on some runs there is a wide variation of the temperatures or in the quantity of goods carried, so that frequently only one machine is required on one port, whereas both machines are required on another.

An ice-machine aboard ship can always be linked in the minds of engineers with a steam-engine, because up until recently steam was, and even is at the present time, the most extensive type of power aboard ship; but the steady increase in the use of internal-combustion engines with their high-efficiency and dependability has put electricity forward as the main driving-unit for all auxiliary equipment. The Brunswick Refrigerating Company have installed a great many of their small units on all forms of vessels and where steam is not available, have driven by chain, belt, spur gear, and most recently by the turbo-gear.

The brine circulating-system is designed for vessels where very large refrigerators or widely scattered compartments are to be cooled. In this system, the ammonia is expanded through a brine-cooler while a small motor-driven pump sucks the brine from a surge-tank, forces it through the brine-cooler and thence to the refrigerators and back to the surge-tank. It is possible to maintain a slightly more even temperature in the refrigerator by means of the brine-circulating system than it is by the direct-expansion system, because a slight variation in the ammonia back-pressure will not affect the brine appreciably, because the brine-coolers will practically run on the flooded system and a comparatively uniform back pressure is in

Generated on 2024-09-13 14:34 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

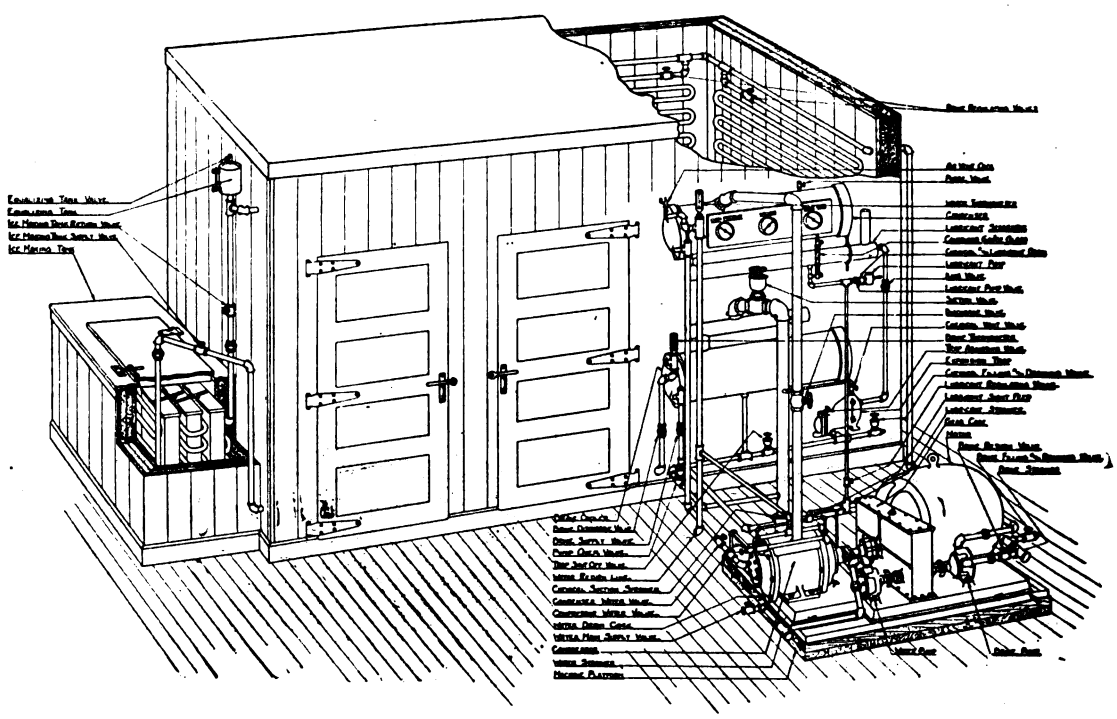
that way maintained. On the other hand, it is not practical to install a brine system for a small job because the expense is not warranted by the small advantage secured, but on a larger installation a brine circulating system is most certainly advisable.

Within a short time, a refrigerating plant will be as much a standard part of the equipment of a motor-ship as a fuel-oil tank is at the present time and a plant can be installed within ten days.

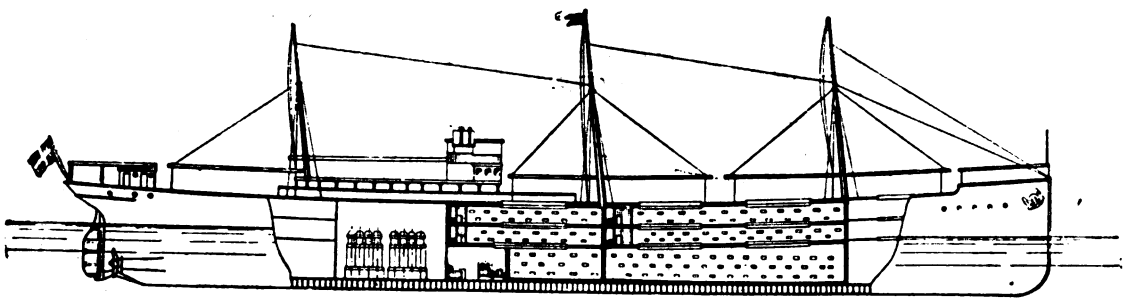
Incidentally we will mention that the two Diesel motor tankers now building for the Standard Oil Co., of Cal.; both have refrigerating appliances furnished by Audiffern & Singvun, but at the moment of writing no details are before us. The refrigerating-rooms are lined with Balsa wood.

In Europe a great number of manufacturers have investigated the rapidly expanding motorship field, with the result that there are some very interesting designs in refrigerating installations. One firm in Denmark; namely, Thomas Ths. Sabroe & Co., Ltd., of Aarhus have equipped many motorships including the "Selandia" (6500 tons); "Fratelli Bachini" ex "Christian X" (6500 tons); "Fionia" (10,000 tons); "Jutlandia (7500 tons); "George Washington" (10,000 tons); and "Afrika" (13,300 tons). The latter has a 100 b.h.p. set.

Sabroe refrigerating-machines also work on the C.O.2 system. The liquefying of the C.O.2 commences in the compressor which acts as an ordinary piston-pump, drawing the C.O.2 in the shape of gas from the coils of the evaporator and compressing it to the liquefying pressure at which it is discharged into the coils of the condenser. In the condenser-coils, around which the cooling-water circulates, the heat due to the compression is absorbed from the C.O.2 and under these circumstances the C.O.2 liquefies. In this condition it is allowed to escape slowly through the regulating-valve into the coils of the evaporator. Incidentally, it may here be stated that the compressor-cylinder is bored out of a solid-steel forging to ensure the greatest strength and freedom from flaws in the material.



Clothel refrigerating system for a motorship



Motorship built for fruit-carrying. Three Diesel-driven fruit carriers of large size are now under construction

By the expansion and consequent evaporation the C.O.2 in the evaporator-coils absorbs great quantities of heat and it is by this absorption of heat that the desired degree of cold is obtained. The heat is taken from the surroundings, which on board ship is generally the brine in the evaporator tanks. The temperature of the brine is thereby reduced to 14 Fahr. or even lower if required.

The brine-pump draws the cold brine from the evaporator and circulates it through the brine grids which are fitted in the space where the cooling is to be supplied for the ship's purposes, containing the refrigerated or frozen goods, in which the air, circulated by a fan, is cooled before being blown into the store or hold.

An advantage of using an air-cooler is, that the degree of humidity contained in the air of the refrigerated space may be regulated as required for the goods stored. The brine grids may also be fitted in an ice-tank in which the daily supply of ice for the passengers and crew may be produced from pure fresh-water.

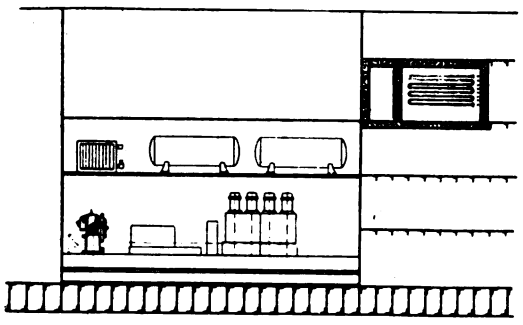
Regarding the construction, we have already referred to the steel compressor cylinders. Compressors-valves as well as the valve-seats are made of special steel, whereas the valve-spindle guides are made of an alloy of hard bronze, specially made for this purpose. Valves and seats are easily accessible, yet well held in place, and they are so fitted that no broken part or pieces of the valve-springs can get into the cylinder. Heavy studs and nuts hold the compressor cover in place. It is not plug-shaped as is the case in some machines, which require very hard tightening to prevent leakage.

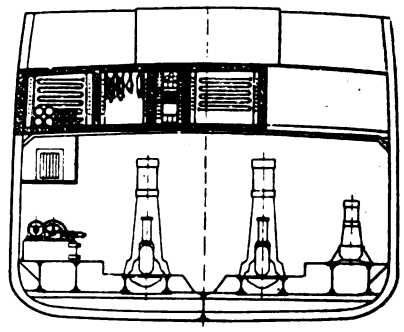
The compressor piston-rod stuffing-box is fitted with leather packing, held against the rod with rubber-rings, but with Sabroe's stuffing-box design no glycerine pump or other mechanical lubricator is required. The gland is lubricated in the ordinary manner by means of an oil-cup and does not require constant pumping by the hand.

All coils for these machines are made of the finest tubes that can be procured, welded together in suitable lengths. The C.O.2 coils are made of extra heavy solid-drawn iron or copper tubes, and the brine coils of tubes of best steam-pipe quality. No coil leaves the works without having been tested to a hydraulic pressure of 3750 lbs. per sq. inch and a C.O.2 pressure of 750 lbs. per sq inch. The coils are painted with a special anticorrosive composition or galvanized as may be required.

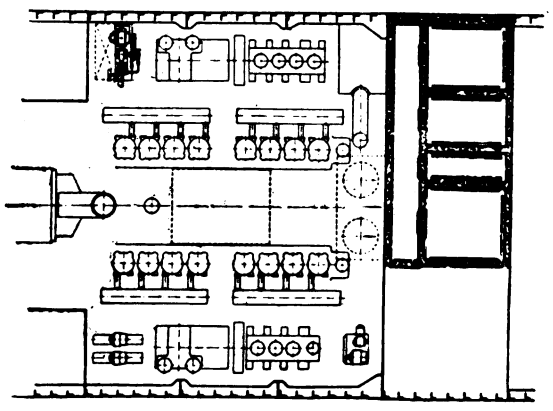
We are enabled to give an illustration of the longitudinal section of a Burmeister & Wain engined-fruit-carrying motorship now nearing completion for Consul Blikstad in Denmark, in which Sabroe refrigerating-machinery is installed. In this case all the cooling-pipes through which the cold brine circulates are arranged as air-coolers, and large fans circulate the air through the air-coolers, and holds where it is evenly distributed by means of air ducts along the ship's sides. These air-ducts are so large that the engineer-in-charge can pass through them to inspect the cargo and the temperature in the holds, and to regulate the distribution of the cold air.

Capacity of refrigerated provision stores		H. P. required in		Approximate weight in tons of machinery and pipe connections in	
Cub. ft.	cub. metres	a) temperate climate	b) tropical climate	a) temperate climate	b) tropical climate
250	7	1,5—2,5	4—6	1—2	2,5—4,5
500	14	2,5—3,5	7—9	1,5—3	4—6
1000	29	3—5	9—11	3—5	6—8
2000	57	5—7	13—17	5—7	8—12
3000	86	6,5—8,5	17—19	7—9	12—14
4500	130	7,5—9,5	20—23	9—11	14—18
6500	185	9—12	26—30	12—15	19—23
8000	230	12—14	43—48	16—18	24—29





Arrangement of Sabroe refrigerating plant for a motorship trading in the Tropics



The above table is worked out to give some idea of the weight and horse-power of a standard refrigerating plant for provision stores in motorships of various sizes.

Generated on 2024-09-13 14:34 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

The above figures are approximate being based on general calculations, and consequently each case must be worked out according to its special requirements.

Lastly, we will again make a reminder that in the September issue of "Motorship" descriptions were given of two 3330 tons d.w.c. Diesel-driven fruit-carrying motorships now building for Mac-Andrews, Ltd., of London, by Wm. Beardmore & Co., of Dalmuir, Glasgow. Very complete refrigerating machinery will be installed on these vessels.

Among the advantages of the Diesel-engine for propulsion in connection with the carriage of fruit or other perishable cargoes likely to deteriorate with a rise of temperature, is the elimination of the stokehold and the radiation of heat therefrom to the holds, thereby ensuring the discharge of cargo in perfect condition, also preventing overworking of the refrigerating machinery.

In a way the Clothel system of refrigerating machinery is a fifth cousin to the motorship industry. It is manufactured by The Clothel Refrigerating Co. of Bayonne, N. J., whose French representatives are Sautter & Harle Co. of Paris, who built the first Diesel-type engine ever installed in a boat, this being a canal-barge and was some time before the date of the early Russian boats, and the "Vulcanus" and "Selandia."

The Clothel system of refrigeration employs Ethyl Chloride, as a refrigerant, this having the lowest pressure of any in present use. The pressure of Ethyl Chloride ranges from a boiling point of from 25 regrees Fahr. to plus 80 degrees Fahr., and a comparative pressure of other commonly used refrigerants from 8 to + 80 degrees Fahr. which will illustrate the advantage of Ethyl Chloride in this respect alone. Safety for Ethyl Chloride is claimed because it is non-poisonous and non-explosive. These are also large factors of benefit in its applications to work aboard ships.

The Clothel Refrigerating machine is designed with a view to minimizing space required and accessibility to all parts. The illustration showing a typical installation of a Clothel machine indicates this point. The compressor is of the rotary type, noiseless, having high-efficiency under all working conditions. The machine itself consists of—compressor, brine-pump, water-pump and electric-motor, or steam-engine, all mounted on a common cast-iron bed. The compressor and two pumps are driven thro silent helical-gears from the motor. All gears and shafts are carried on ball-bearings. An enclosed gear-case, allowing the gears to be provided with grease, adds to the silence as well as durability of the equipment. The brine-cooler and condenser are of the horizonal type and the special Clothel U-tube design allows all the tubes to float in the shell, preventing any possibility of leaks due to distortion from expansion and contraction. The unit as set up occupies very small space.

Notes and News from Everywhere

DIESEL OIL AT THE PANAMA CANAL

One of the 55,000-bbl. oil tanks at the Atlantic Terminus of the Panama Canal has been devoted to the storage of Diesel fuel-oil for sale to merchant motorships and is available at $4.50 per bbl.

HUDSON BAY CO. MOTORSHIP

In a new 700 tons d.w. auxiliary schooner building at the yard of the British Columbia Marine Ltd., Vancouver, Canada, for the Hudson Bay Co. at 360 b.h.p. Beardmore surface-ignition oil-engine is being installed.

INCREASE OF CAPITAL STOCK

We understand that the capital stock of Thomas Fleming Day., Inc., marine equipment dealers, has been increased to $100,000.00. Our old friend, Captain Thomas Fleming Day is president of this company.

MOTORSHIP "LIMBURG" FITTED WITH BOLINDER ENGINES

The 1,221 tons gross oil-carrying barge "Limburg" built in 1909 for the Nederlandsch Indische Tankstoomboot Matts., has been fitted with twin-4-cylinder 320 b.h.p. Bolinder oil-engines.

AMERICAN STEEL FOR DANISH MOTORSHIPS

For two 6,000 tons d.w.c. Diesel-driven motorships being built for the Det Kobenhavnske Dampskibesselskab, of Copenhagen, and for the Gylfe Dampskibesselskab, respectively, by the Baltica Shipyard of the same city, 2,400 tons of constructional materials are being shipped from the United States.

COCOANUT OIL CARRYING TANKER

The 6,500 tons d.w.c. Diesel-driven vessel now being built for Spanish owners by Sir Wm. Armstrong, Whitworth & Co., will carry cocoanut-oil from the Philippines to Spain. She will be propelled by two Armstrong-Sulzer 1,350 shaft h.p. Diesel-engines at 11½ knots.

HYDRAULIC TRANSMISSION FOR MOTORSHIPS

Once more experiments are to be made in connection with hydraulic transmission of power in merchant ships. Recently tests were carried-out in England in connection with a Hele-Shaw hydraulic-clutch capable of transmitting over 1,200 b.h.p. by W. H. Dorman & Co., Ltd.

THE ARDROSSAN MOTORSHIPS

The propelling machinery of the three motorships building at the Ardrossan shipyard to have B. & W. Diesel engines will be supplied direct from Copenhagen, Denmark, by Burmeister & Wain. The other two motorships building at this yard will have Werkspoor Diesel-engines installed. The latter will be built under license by Hawthorne, Leslie & Co. of Hebburn-on-Tyne.

MOTORSHIP "TISNAREN" MAKES 15-KNOTS

Readers of "Motorship" will remember the three 9,400 tons motorships "Bullaren," "Tisnaren" and "Elmaren," all of which have been described and illustrated in our pages. These vessels are twin-screw boats with two 2,000 i.h.p. Burmeister & Wain four-cycle Diesel engines. Originally, cast-steel propellers were fitted, but these have been replaced with bronze propellers. On the first 150 nautical miles trip from Malmo to Gothenburg with the new propellers the motorship "Tisnaren" averaged over 15 knots when light-loaded with a few thousand tons of cargo and fuel-oil. The patent Sal Log installed was only gauged up to 15-knots, so the indicator came to a dead stop against the 15-knot mark, but an observation on land made the speed over 15 knots.

SINGLE-SCREW MOTORSHIP "SARDINIA" LAUNCHED

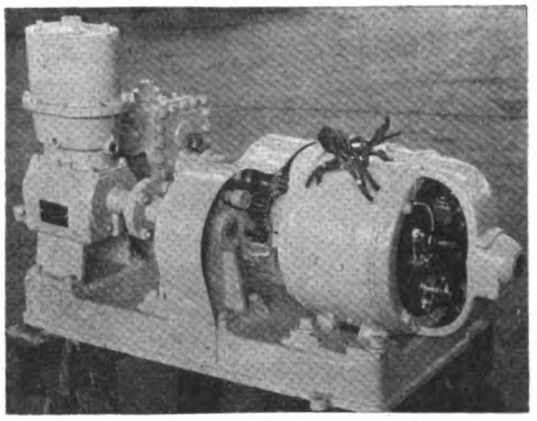
The new motorship "Sardinia" of the Otto & Thor Thoresen Line, Kristiania, Norway, has been launched by J. & K. Smit & Son, Kinderdyk, Holland. She is a single-screw vessel and is fitted by one 1940 to 2150 i.h.p. six-cylinder Werkspoor four-cycle Diesel-engine. Her dimensions are:

Dead-weight-capacity	3,000 tons
Power	2,150 i.h.p.
Speed	14 knots
Revolutions	110 R.P.M.
Length	302 ft. 0 in.
Breadth	42 ft. 4 in.
Depth	28 ft. 4 in.

This vessel has the largest sized Werkspoor engine yet completed, and is similar in power to the engines to be built under license by the Newport News Shipbuilding & Dry Dock Co.

WINTON PUMPING SET

A very interesting pumping set has recently been produced by the Winton Engine Co. of Cleveland, Ohio. It is a combination set and in addition to a rotary water-pump it has a small air-compressor for providing compressed-air for starting small engines or for blowing syrens. The air-pump displaces 2 cu. ft. of atmosphere per minute at 700 r.p.m. The electric motor is of 1½ h.p. at 115 r.p.m. and drives both water and air pumps through gearing at 700 w.p.m., both the latter operating separately.



Winton pumping set

DEATH OF MR. WM. T. PRICE

We deeply regret to learn of the death, after a very short illness, of Mr. William Tudor Price, President of the Price Engine Corporation. Mr. Price was very well-known in marine and stationary oil-engine circles and at the present time the Ingersoll-Rand Co. are building a 1700 b.h.p. marine oil-engine of the opposed-mechanical-injection type from his patents and designs. For a considerable time Mr. Price was Chief-Engineer of the De La Vergne Machine Co. of New York, and was also known for his unusual ability as a sales-engineer. He left that company to form the P. R. Engineering Corp. for developing his own design of oil-engine. Later this was absorbed by the Ingersoll-Rand Co. with whom he became connected. As we write no details of his illness are before us, except that he was down with pneumonia for about four days and died in a hospital. He leaves a wife and five children to whom our sincere condolences are offered.

DENNY-SULZER MOTOR TANKER

The Diesel-driven tank-ship which Wm. Denny & Bros. of Dumbarton, Scotland, are building for the British Tanker Co., Ltd., will be of 10,000 tons d.w.c., and will be propelled by twin 1,350 shaft h.p. two-cycle type Denny-Sulzer four-cylinder Diesel engines. Length 425 ft. B. P., breadth 56 ft. 8 in., depth 33 ft.

MARINE DIESEL-ENGINE WITH 12½ H. P. CYLINDER OUTPUT

A four-cylinder, four-cycle marine-type Diesel oil-engine developing 50 b.h.p. at 550 r.p.m. and driving a 30 in. dia. propeller has been installed in small boat in Scotland. This little Diesel engine is made by the A. B. Atlas Diesels Motorer, Stockholm, Sweden, the American licensees being McIntosh & Seymour Corp. of Auburn, N. Y.

LUSTER PLANT PURCHASED

Fairbanks, Morse & Co., have purchased the entire business consisting of all stock on hand, good will and liabilities of the Luster Machine Shop and Railway Equipment Co., 917 Arch Street., Philadelphia. Fairbanks-Morse have opened a new branch at this address under the management of Mr. D. W. Dunn, and will sell their complete line of engines, motors, pumps, etc. The entire personnell of the Luster Machinery Co., has been retained. Mr. E. J. Luster, former president, will be manager of the Machine Tool Division of the Fairbanks-Morse Philadelphia branch.

AMERICAN DIESEL-ENGINE REPRESENTATIVES IN CANADA

We understand that an agency for the McIntosh & Seymour marine Diesel engine has been acquired by the Pyke Motor & Yacht Company, who have opened up a store and show-room at 374 Notre Dame St. West, Montreal. We also understand that they have acquired an agency for the Burnoil engine as manufactured by the Dodge Sales & Engineering Company of Mishawaka, Ind. Mr. J. A. Pyke, President of this company, advised us that he has just secured a charter for $200,000.00, of which over one-half is already fully paid, and the balance will be disposed of in shares of $100 each, with only one share per person. The entire top floor of their building is devoted to rebuilding marine engines, and expert repair men are employed the year round.

NEW MARINE ENGINEERING AND SHIP BROKERAGE OFFICE OPENED

We understand that the Maritime Engineering and Sales Corporation, incorporated in September of this year, has established its principal offices at No. 2 Rector Street, New York, and will conduct a ship brokerage and marine-engineering business, specializing as Consulting Engineers for and in the sale of auxiliary and deck machinery and equipment, cargo handling-gear, also Diesel and electric propulsion of ships. Branch offices or agencies will be established in the Great Lakes District, Atlantic Coast Ports and the Gulf District. Mr. George H. Jett has been elected President and Treasurer and Mr. I. F. Halton, Vice-President and Secretary.

Arrangements have been made with the well-known firm of Allan Cunningham Company, Inc., whereby the Maritime Engineering and Sales Corporation will act as sole-distributors of Cunningham marine machinery and equipment in the Great Lakes, Atlantic Coast and Gulf Districts, their electric machinery especially having gained national recognition among shipbuilders and operators.

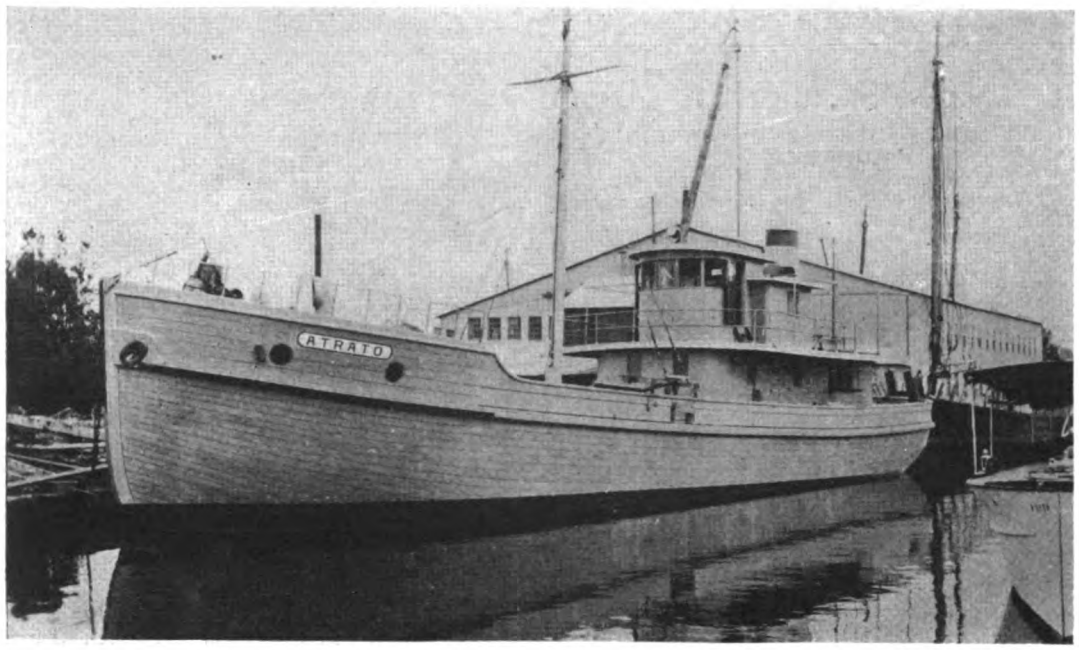
The Company will give particular attention to the study of the matter of cargo handling, especially with the idea in view of promoting the use of electrical equipment for this purpose. They have on their staff thoroughly experienced and competent electrical and marine engineers.

Generated on 2024-09-13 14:36 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Small Motorship for Carib Company

Twin-Screw Bolinder-engined Wooden Vessel For Columbian and Venezuelan Coast-wise Trade

AMONG companies making a deeper entry into the motorship operating field as the results of their initial oil-engined vessels may be mentioned that of the Carib Trading Company, which is a subsidiary of the well-known Carib Syndicate, 90 West Street, New York, who recently accepted delivery of their fourth oil engined vessel, and who have additional boats on order, one of the latter being a single-screw-vessel fitted with a 100 b.h.p. Bolinder oil-engine now building at Cartagena.



The Carib Company's motor-freighter "Atrato." She is equipped with Columbian Bronze Propeller

The "Atrato" which is the fourth of their motorcraft to be accepted is a small vessel of wooden construction, to be used for trading on the Columbian and Venezuelan coasts, and will shortly proceed to South America under her own power. She was built by Smith & Williams of Salisbury, Md., and was recently in New York—having averaged 11 knots speed on the voyage here, with 20 tons of cargo in addition to fuel.

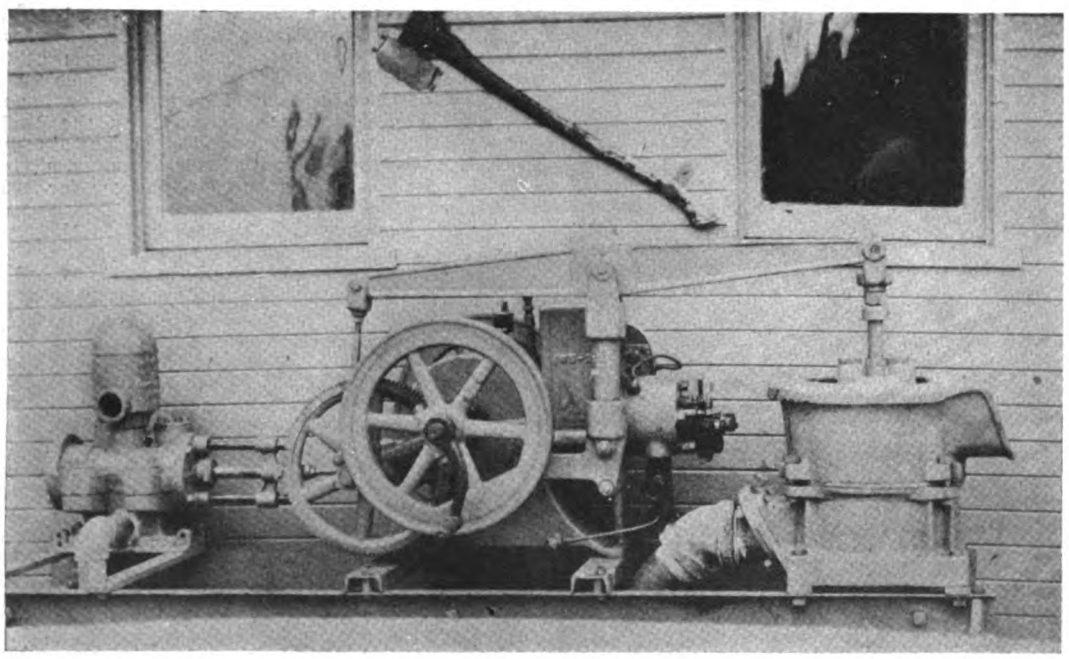
She is quite a small vessel, having the following dimensions:

Dead-weight-capacity	350 tons
Length	100 ft.
Breadth	24 ft. 6 in.
Depth of hold	7 ft.
Loaded draught	6 ft.
Light draught	4 ft. 6 in.
Power	180 h. p.
Speed (light)	11 knots

She is propelled by two of the latest type twin-cylinder Bolinder oil-engines with water cooled heaters, and with which there is a continuous high-pressure air-blast in connection with the injection-fuel. Unlike the Diesel engines this air-blast does not inject the fuel, but is continually blowing-in the working-cylinders even while combustion is taking place.

A two-stage air-compressor for this purpose is mounted on the forward end of the engine. We understand that she will have a captain, chief-engineer and assistant-engineer, who will be the only white men on board, all the rest of the crew will be colored.

On deck there is a Loane sail-hoist driven by a gasolene engine, electric ignition for which is furnished by a Webster Polar oscillator. There is also a bilge and wash-deck pumping-set on the deck forward of the saloon and wheel-house structure.



Loane bilge and wash-deck pumping set on deck of motorship "Atrato"

On the upper deck two life-boats are carried, one being a Wellin steel double-ended boat. In the engine-room there is a gasolene-driven Delco electric-lighting plant. Two Exide storage batteries are also installed for electric-lighting purposes; and there is a Fairbanks-Morse gasolene-driven emergency air-compressor. In view of the gasolene auxiliary machinery it was very important to install fire extinguishers, and a considerable number of these are carried in the engine-room and cabins. These are of the John Mansville "Success" type.

Other boats in their service are the "Sinu," a small freighter of 100 d.w. capacity built in 1916 and propelled by a 100 b.h.p. Bolinder oil-engine, the "Cauca" a small freighter with a 50 b.h.p. Bolinder oil-engine and the "Victoria" a 70 ft. barge.

MR. A. E. DOXFORD'S* PRESIDENTIAL ADDRESS BEFORE N. E. COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

[Space is not available in "Motorship" for the most excellent address recently made by Mr. A. Ernest Doxford, so we only reproduce that part relative to the oil-engine. Mr. Doxford is the head of the well-known British firm of steamship builders—Wm. Doxford & Sons., Ltd., Sunderland, so his views on the oil-engine are of importance to all shipowners.—Editor.]

You all know of the rapidly increasing interest that is being taken in the question of internal-combustion engines, and I will very briefly review the history of their development. We have to go back 100 years to find the first engine, which is described in the first volume of the Philosophical Society of Cambridge; but apparently the matter was not carried any further until 1860 when Lenoir built a double-acting, electric-ignition gas-engine of 75 mm. bore × 140 mm. stroke, working without compression; this was 50 years after the installation of the first public gas-works.

During the next 10 years developments were made in gas engines by Hugon, who employed flame ignition, by Bisschop, who provided ribs to the cylinders for air cooling, and by Otto and Langen, who used flying pistons. The consumption of gas in these engines was: Lenoir 4.29 cbm/B.H.P./hr. Hugon, 2.57, and Otto and Langen, 1.72; or in the proportion of 10:6:4.

In 1873 Brayton, an American, produced a gas-engine in which the gas burned slowly, roughly speaking at constant pressure, and he got a consumption of 1.54 cbm/B.H.P./hr.

In 1893, 20 years after Brayton, Rudolph Diesel invented a constant-pressure oil-engine, and this has remained the most economical prime-mover known to the present day.

It was Diesel's invention that awoke engineers to the great possibilities of the internal-combustion engine, and from 1893 down to to-day there has been a steady progress in reducing consumption, in simplifying design and in increasing sizes. The first commercial Diesel motor was built by the Machinenfrabriek, Augsburg, in 1898, and it consumed 0.53 lbs. of paraffin/B.H.P./hr. In 1900 this was reduced to 0.45 lbs.

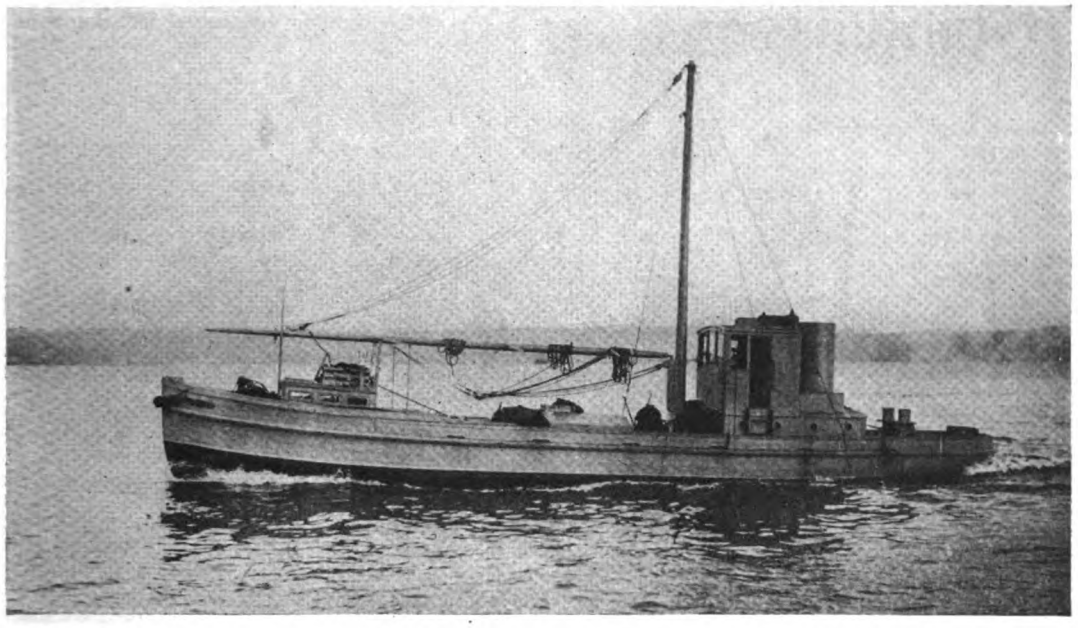
About this time the best results obtained by British manufacturers was 0·7 lbs., but to-day they claim to have reduced this to 0·38 lbs. Not only has the fuel-consumption been thus greatly reduced, but also the quality of the fuel used has been experimented with, and now the cheaper grades of oil can be burned with perfectly satistory results. The size also has increased rapidly, and now commercial engines with an output per cylinder of 700 B.H.P. at 77 revolutions are being built.

Regarding design, it is as much in the attention to the minutest details as in radical changes that success has been achieved. With figures such as I have mentioned it was natural that marine-engineers should turn their attention to this undoubtedly economical engine, and in 1904 the first marine Diesel-engine of 250 h.p. was installed by Messrs. Nobel; this was a non-reversible engine with electric drive. The first reversible Diesel was built by Sulzer in 1906 and was of the two-stroke cycle type. From this time onwards large numbers of vessels have had Diesel engines installed. As was only natural while the engine was, if not exactly in an experimental stage, at least in a state of evolution, the success attained has varied considerably, *but to-day, I think we may say that designs have settled down into well defined lines and the shipowner need not hesitate on the ground of the engine being experimental.*

MOTOR TANKERS "WOTAN" AND "LOKI"

According to a report published in England the U. S. Shipping Board have acquired the large Diesel-driven tankers "Wotan" and "Loki" originally owned by the German subsidiary of the Standard Oil Co. of N. J., but lying idle in the Firth of Forth since the Armistice. The "Wotan" is driven by a single 1,800 shaft h.p. Carels Diesel engine, while the "Loki" has two 1,250 shaft h.p. Krupp Diesel engines.

Generated on 2024-09-13 14:39 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN



Re-constructed motor-tug powered with 60 b.h.p. Mianus Leisner high-compression oil-engine.

RECONSTRUCTED MOTOR-TUG FOR SOUTH AMERICA

The reconstruction of a wooden motor-tug has just been carried-out under the supervision of Tams, Lemoine & Crane, of New York. This tug was recently purchased by the Liberty Development Co. for use in South America, and was equipped with a 60 h.p. gasolene engine way up forward, necessitating the use of paving plugs, etc. to keep the hull in trim. She was of rather light construction and practically everything has been rebuilt except the hull which has been strengthened by means of trusses to carry the cargo that she will also have to handle when in Southern waters. The gasolene engine has been removed and in its place a 60 b.h.p. Mianus Leisner type oil-engine has been installed.

This craft will be used in British Guiana for towing deck-load barges, one on either side, and for carrying machinery on her deck and in her hold, the capacity being about 25 tons. She is 64 ft. 6 in. long with 15 ft. breadth and 5 ft. draught, and on trial with a towing wheel and the engine half-open she made about 8¼ knots. On a four-hour test the engine functioned excellently, and we are advised by the Naval Architects that it is comparatively quiet, clean and economical. It takes up its load without staggering, and is equipped with a governor that prevents her running up more than 10 or 15 revolutions per minute when the load is taken off.

Silencers for Motorships

Details of the Maxim Device

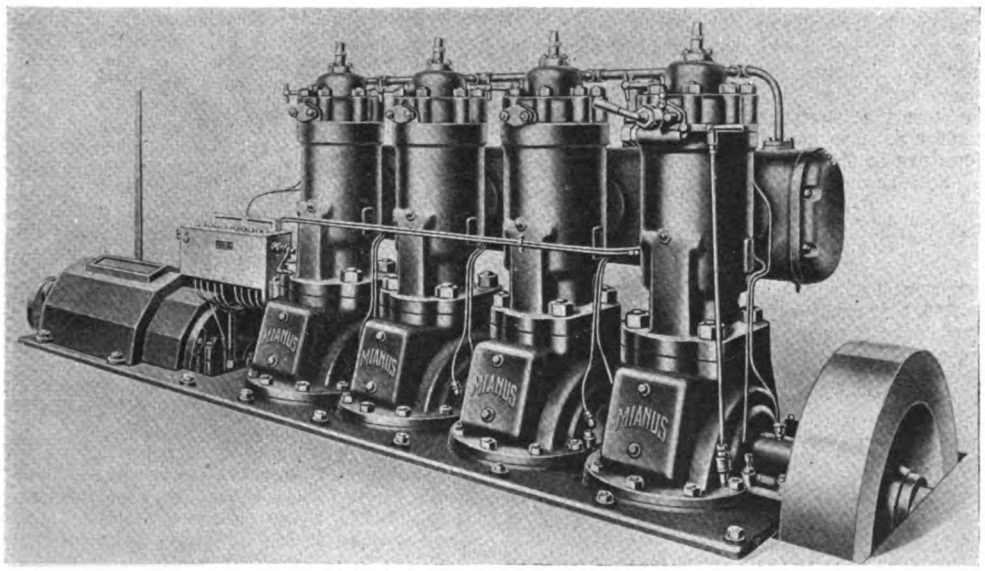
CONSIDERABLE interest attaches to the news that the Maxim Silencer has been applied to the exhaust of large Diesel engines for merchant marine service. As will be recalled, this device was developed some years ago for silencing the report of fire arms. Soon thereafter the principle was applied to the exhaust of small two-cycle boat engines, with very successful results. One of the oldest ship-chandlery manufacturing companies in the country, Messrs. Wilcox, Crittenden & Co. of Middletown, Conn., have made Maxim Marine Silencers for small engines for several years past. Later on a demand for the reduction of the noise of stationary gas-engines and also air compressors, and the discharge of various forms of compressed air machinery, caused the development of the silencing principle still farther. During the war Mr. Hiram Percy Maxim, the inventor, was requested to apply the principle to silencing the exhaust and also the air-intake of large Diesel-engines of motorships. The marine construction was taken up by the McIntosh & Seymour Corporation of Auburn, N. Y., and the latter company has built and installed a large number of Maxim silencers, both on ship board and in stationary plants.

This silencer consists of a method of treating two kinds of noises. One of these noises is called the "primary" noise, and the other the "secondary" noise. The primary noise is the term given to the original noise wave that is created when the exhaust-gases are suddenly liberated by either the exhaust-valve or by the uncovering of the exhaust-port. It is said that this primary noise is the sharper of the two, and the one possessing the great carrying power which we recognize as characteristic of internal combustion engines. The secondary noise is the noise which is created by the discharge of high-velocity gases as they enter the atmosphere.

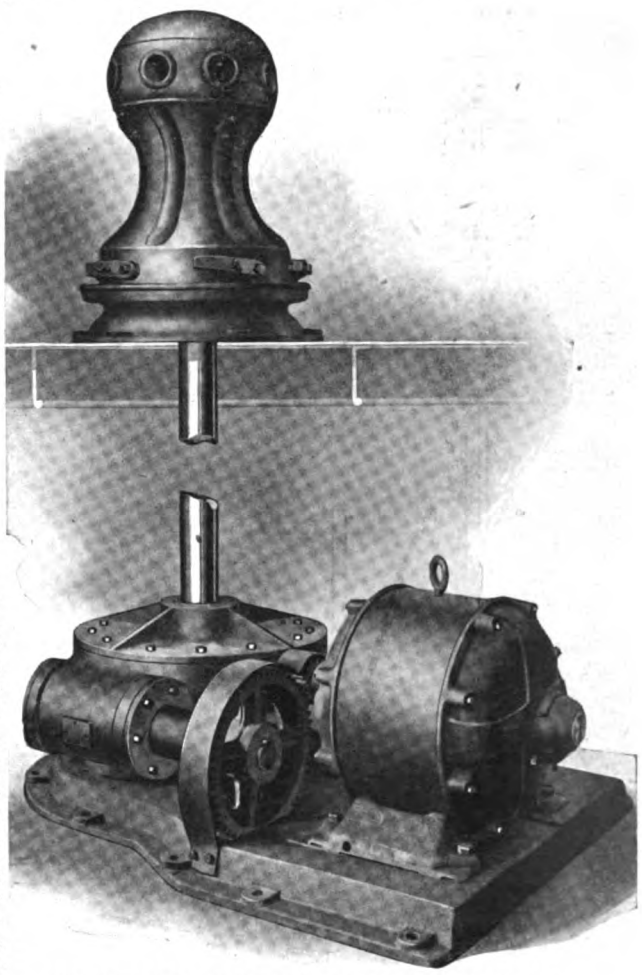
It is said that this double character of the exhaust noise was determined as a result of the discovery that in the discharge of a rifle, there are two distinct and separate noises. One of these is the report noise, which the silencer annuls, and the other is the bullet-flight noise, which the silencer cannot control. The bullet-flight noise is a very sharp crack, and it is stated that there is no possibility of its ever being silenced where the bullet velocity exceeds the velocity of sound.

In his study of the noises in a fire-arm discharge, Mr. Maxim was led to believe that the same thing might be expected in the exhaust of an internal-combustion engine. It was later found by photography to be the case, and in the Maxim exhaust-silencer a dual system of silencing is provided. It is said that any degree of noise reduction desired can be attained. This is important on ships navigating difficult waters in fog where the echo of the whistle is largely depended upon for judging position. Under these circumstances, the operation of the vessel must be almost silent as heard from the navigating bridge, and some very successful results have been obtained in this service by the Maxim silencer.

It is of additional engineering interest to realize that in many cases, the silencer is utilized on the air-intake of large Diesel engines.



The 60 h.p. Mianus modified Diesel type marine oil-engine



Single barrel electric-driven capstan manufactured by the American Engineering Co., Philadelphia, Pa.

CAPSTANS FOR MOTORSHIPS

An interesting catalogue dealing with electric and steam capstans has been issued by the American Engineering Co. of Philadelphia and we have copy before us.

We reproduce an illustration of a single-barrel type electric-driven capstan built by this company. This arrangement provides for hand operation through the head, which is keyed to the vertical shaft. The barrel runs free on the shaft, but may be keyed to it through the capstan-head by means of a block-key. The barrel then turns with the shaft. If the block-key is placed in the base, the internal gearing is locked and the barrel then runs in a counter direction to that of the shaft, and at a slower speed. It is advisable always to run the barrel right handed to avoid untwisting the rope. Under power conditions, this necessitates reversing the motor when the block-key is shifted. To operate by hand, the motor is disconnected at the worm-wheel head, and power applied at the capstan-head by means of bars. Change of speed and pull is made by shifting the block-key and reversing the travel of the bars. Pawls on the lower rim of the capstan barrel prevent overhauling when operating by hand.

Generated on 2024-09-13 14:35 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Our Readers' Opinions

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

TWO-CYCLE VERSUS FOUR-CYCLE

To the Editor of "Motorship."

Sir:

In your June number some details were published on the motorship "Salerno," and, in the same article, reference is also made to the Sulzer Two-Cycle Engine, or rather to the particulars of dimensions and weights given in the article on "Sulzer Two-Cycle Marine Engines," which appeared in your March and April numbers. In this connection the author, "Starboard Watch," compares engines with one another which really do not lend themselves to comparison. We stated clearly in our article that the weights and other data given by us were suitable for both four-cycle and two-cycle engines, if designed and constructed on similar lines. But "Starboard Watch" neglects this entirely.

(1) He compares four-cycle engines running at 125 r.p.m. with two-cycle engines running at only 85 r. p. m.; i. e., the propeller efficiency in the ship with his four-cycle engines will of course be much lower than that in the case of the ship with our two-cycle engines.

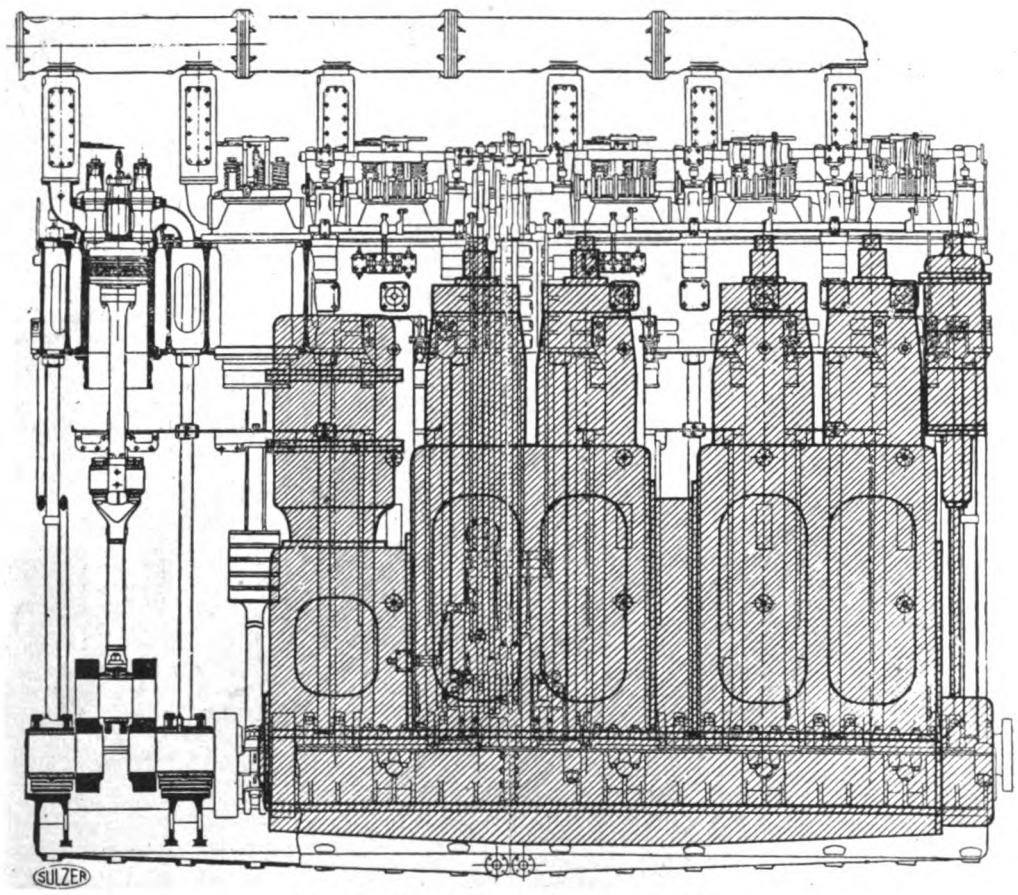


Diagram illustrating Sulzer-Freres letter

(2) The ratio of stroke to bore in his engine is 1.78, in ours only 1.6; his engine will thus be reduced in length but increased in height.

(3) The ratio of the length of the connecting-rod to crank radius in his engine is 1 to 4, as compared to our 1 to 4.5; the transverse pressure on the crosshead is therefore much higher in the four-cycle engine than in our two-cycle type.

(4) The piston-speed in his engine is 4.17 metres per second, in ours only 3.54; the working conditions for his pistons, as regards wear, etc., will of course be much worse.

(5) The injection-air compressor is fitted at the back of a working cylinder and not driven from the lengthened crankshaft; this cylinder is therefore not accessible for inspection and overhaul.

(6) Instead of being supported on strong frames, the cylinders rest only on comparatively light steel columns, a form of construction which, we might mention, was originated for Diesel engines by our firm, but afterwards abandoned. This means a saving in weight, but at the expense of rigidity, and it would seem that the American licensees of Werkspoor have given-up this system of construction for this reason.

The above comparisons will at once show the observant reader at what cost the saving in weight has been attained. We hold that such constructional data and arrangements are not very suitable for following in designing an engine for the propulsion of cargo boats. Such figures are too little in conformity with the requirements of a reliable and trustworthy installation. This opinion of ours is also confirmed by the fact that other firms building four-cycle engines do not adopt such extremes in construction, and, except for the speed, keep more within the constructional limits we have adopted for our engines.

If our engines were designed on the lines of the engines of the "Salerno" and run at the higher speed of 125 r. p. m., the weight of a Sulzer two-cycle installation would be reduced to about 165 tons; i.e., as compared with a four-cycle installation of about 240 tons, a difference in weight of about 75 tons would be realized. In other words, the weights of the two installations would be in much the same proportion as determined in our article.

The accompanying illustration shows the outline of a Sulzer two-cycle engine, designed on the principles suggested by "Starboard Watch," and compared with the four-cycle engines of the "Salerno." It is at once evident from this, that a Sulzer two-cycle engine, of the same power and running at the same speed as the four-cycle engine, is much smaller, and therefore, logically, much lighter.

"Starboard Watch" also gives weights for a large installation. We are inclined to think that these weights have been only roughly estimated, as the data are too greatly in conflict with the general rule that the weights of reciprocating steam-engines vary as the swept cylinder-volume. When one considers that the speed of these large engines is only 100 r. p. m. as compared with the 125 r. p. m. of the engines in the "Salerno," the swept cylinder volume, and therefore also the weight, must be

$$\frac{125}{100} \times \frac{4280}{2560} = 2.09$$

times greater; i.e., equal to about 500 tons, instead of only 360 tons as given by "Starboard Watch." Mr. Richardson, as representative of a firm building four-cycle engines, in his letter in the May number of "Motorship," also agrees that the weights of four-cycle engines vary in proportion to the swept cylinder volume, and therefore the data as regards weight given by "Starboard Watch" must be considered absolutely incorrect.

If the supporters of the four-cycle engine really desire that the question of four-cycle versus two-cycle be properly discussed, they must put forward their arguments, if they want them to make any impression, with a fuller recognition of the technical facts of the case.

It is clear from what "Starboard Watch" says in his article, that he has taken no account of the fact that different types of engines can be compared only when they are, as far as possible, of similar construction and design, and work under similar conditions.

Yours faithfully,
SULZER BROTHERS.

Winterthur, Switzerland.

TWO-CYCLE VERSUS FOUR-CYCLE

To the Editor of "The Motorship,"

Sir:

Lately there has been considerable correspondence in your columns as to which marine Diesel engine, the two-cycle or the four-cycle type is the lighter and smaller. Your several correspondents have challenged each others' figures and much misunderstanding and haze covering the real issue has been created. There are some distinct points which must be kept carefully separate. In a letter from Sulzer Bros. (copy of which you kindly sent us in advance of publication) it is said that the different types of engines can only be compared if they are as far as possible of similar construction and design and work under similar conditions. Now this is one way of looking at the matter. Under these conditions there is nobody who will maintain that a four-cycle engine is lighter or smaller than a two-cycle engine. Everything written in the articles by Sulzer Bros. in your March and April issues then holds largely true.

There is, however, another way of comparing the two types and that is, by comparing the most successful makes of each type with each other irrespective of similarity of design. The great point happens to be that a four-cycle engine, because of its nature, allows of a different design that is much lighter and more compact than that of the most successful two-cycle engine. This great advantage of the four-cycle system is not allowed for when comparing the two types in the way Sulzer Bros. do. The four-cycle engine can be run safely at a higher number of revolutions than the two-cycle engine, which by the way in a twin-screw job, but hardly impairs the propellor efficiency. The four cycle engine can be safely built on steel columns with less heavy castings than the two-cycle engine. Consequently it is idle to say *"if a two-cycle engine was constructed on the lines of the engines of the 'Salerno'."* It could not be done!

The two-cycle engine of the port-scavenging type must have a cylinder twice as long as that of the four-cycle engine with intricate passages cast into it, and also needs large air-ducts and scavenging-pumps.

Now for the correct figures! To begin with, let it be clearly understood that there are many considerations besides weight and length of engine which determine the suitability of an engine for a cargo ship; but, as these points have now been raised I will give the figures bearing on them.

To my regret only the figures concerning the Werkspoor engine can be given. The size and weight of the very successful Burmeister & Wain engine will be only slightly in excess of these. The weight of the standard 1000 brake H.P. Werkspoor engine is per motor (without thrust-bearing but including exhaust piping) 125 tons. *This is actually weighed*, not estimated or calculated. As to the weight of the larger engine under discussion, this has not yet been accurately determined, but as the weights and cylinder-volume are known not to be proportionate but rather to follow a square root law the weight of the 1500 brake H.P. Werkspoor engine can be safely estimated at 170 tons. In the article by Sulzer Bros. they give as the weight of their own engine of 1600 B.H.P. 210 tons. This supposedly includes a Kingsbury thrust-bearing for which say 10 tons is ample, leaving 200 tons. It will be clearly seen that the greater weight of this engine cannot be denied.

The length of the 1500 B.H.P. Werkspoor engine without thrust-bearing is 34 feet. The length of a similar Sulzer engine is not known, but from the illustration in the article referred to it scales off to 36 feet 6 inches (not including flywheel and thrust-bearing). This is greater than the length of the Werkspoor four-cycle engine.

The fact that there are now 13 ships successfully running with Werkspoor engines of over 900 B.H.P. each and of identically the same light design, is sufficient proof that this design is absolutely reliable and the saving in weight has not been attained at too great a cost.

Mr. Editor, it has not been my intention to enter into a discussion as to the greater suitability for marine service of either type of engine. It can safely be said, that for a long time to come each type will have its field of usefulness in which its special merits will cause it to be preferred, and the question of weight and length will soon be considered less important details. Yet to take away

Generated on 2024-09-13 14:35 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

any wrong impression which the public might tend to form concerning the relation of the two types I think the above data will be found interesting.

I agree with you that the literary efforts of oil-engine builders could be more profitably directed towards pointing-out the great saving effected by motorships over their steam-driven sisters, and in connection with this it might be of interest to you that the Werkspoor-engined motorship "Athene" on her maiden trip from Rotterdam to Montreal, according to the captain's report, had a fuel-consumption of 8 tons per day. The ship ran at reduced speed, about 9½ knots, but for a ship of 3250 net reg. tons this is not bad.

Yours very truly,
For the Werkspoor Co.,
J. MUYSKEN, JR.

Amsterdam, Holland,
Oct. 15, 1920.

[Our Readers' Opinions page was held over last month so a copy of Sulzer's letter was sent to Amsterdam to enable Messrs. Werkspoor to reply, affording them a similar privilege to that recently given Sulzer Frères under similar circumstances.—*Editor.*]

LORD PIRRIE DEPLORES USE OF OIL UNDER BOILERS

To the Editor of "Motorship,"
Sir:

My object in coming to New York is mainly in connection with the supply of oil-fuel which has developed into a very important element in connection with shipping—more particularly as regards the future.

I have held strong views for the last ten or fifteen years that it is a wrong principle to burn oil merely as fuel. At the same time, the Diesel-engine will require great care in manufacturing as well as developing slowly. Personally I feel so concerned after having recommended so many of my shipowning friends to convert for oil-fuel consumption, which undoubtedly is a most extravagant way of using such a valuable commodity, and I fear that only such vessels as the "Olympic," "Aquitania" and a few other similar express passenger-liners, will be secure for future oil supplies, and am therefore advising friends to stop converting ordinary cargo vessels.

So serious is the position that I am not at all sure but that the American Government will probably place restrictions on the use of oil in shipping when other fuels are available, and so anxious am I regarding the general position that I am, with others concerned, leaving for Mexico tonight to study the question on the spot. Until ship owners are quite satisfied that there will be an abundant supply of oil available, naturally they are inclined to proceed warily. Oil will, no doubt, be available in large quantities to vessels employed in certain trades, but there is a possibility that any shipowner or ship-builder preceding without careful discrimination may be landed into difficulties.

Until Mexico gets into a more settled state my feeling is that there is great insecurity in going in for too large a programme of vessels built for oil-fired boiler consumption, more particularly as at the present time we are relying to a very large extent upon the production of the Mexican Oil Fields. Every step should be taken to prevent wasteful use and the consequent exhaustion of supplies. This can only be done by the adoption of the internal-combustion engine, but today it would be a great responsibility for any ship-builder to advocate this, as, with Diesel engines, if oil could not be obtained in the trades in which such vessels are employed, they would be absolutely useless. It is no doubt for this reason that so many ship-owners are probably wise in only using oil at present for burning, until they are absolutely satisfied that there will be a certainty of future supplies, as in such circumstances, they always have the option with little difficulty of going back again to coal burning.

Yours very truly,
PIRRIE.

Hotel Plaza, New York,
November 9th, 1920.

[Many British shipping companies with whom Lord Pirrie is associated are building large numbers of Diesel-driven motorships—some of them to the total exclusion of oil-fired steamships. We have to remember that with fewer oil-fired steamers left in service and more economical Diesel vessels built, there will be a greatly reduced demand upon the fuel-oil supply, and oil will drop in price, and greater quantities will be available in the future.—*Editor.*]

OIL ENGINES OF THE FUTURE

To the Editor of "Motorship,"
Sir:

In your September issue of this year just to hand there is an interesting article by Mr. Otto Alt and there is nothing against its correctives.

But I would advise that other crude-oil engines than Diesels have arrived at a fuel-economy of 36.5% and that there is a true theoretical way not hitherto proven to get 42% out of fast energy by a special crude-oil engine.

Air-injection of fuel is not the right way to get at this, nor the high pressures in the Krupps engines by superchanging. In the next two years a new engine will appear with such a higher economy than any other engine in existence and it will be simpler and more reliable than the high-pressure engines of the day.

In the near future the "semi-Diesel" engine will appear with 34% economy and in units as great as Diesel engines. But to realize this new proposition will cost money and these are not easy to get at from pure experimental purposes.

Yours very truly,
HUGO MOREN.

Experimenting Engineer
on Crude-Oil engines.
Ràsunda, Sweden

THE M. S. "ANSALDO SAN GIORGIO I"

To the Editor of "Motorship":
Sir:

We have noted with great pleasure the illustrated article on our motorship "Ansaldo San Giorgio I." Our firm is a regular subscriber to your important review, and has had previous opportunity of apreciating your interest in Italian motorship building. I am glad to say that the sister motorships to the "Ansaldo San Giorgio I" are giving every satisfaction. They are running regularly on the Pacific Line through the Panama Canal to which the "Ansaldo San Giorgio I" will now revert.

Yours very truly,
N. SOLIANI,
Director.

Societa Nazionale di Navigazione.
Sapital L. 150,000,000.00
Genoa, Italy

RE "ANSALDO S. GIORGIO'S" INTERNAL COMBUSTION ENGINES

Torino, 22d October, 1920.

To the Editor of "Motorship":
Sir:

In the October issue of "Motorship," in the article concerning the activity of the "Ansaldo San Giorgio" generally, and motor-vessels particularly, I have noticed the assertion that the construction of "Ansaldo San Giorgio" internal-combustion engines has been influenced by the fact that:

(a) I am an ex-Sulzer man;

(b) Messrs. Gio. Ansaldo & Co. are licensees of Sulzer Frères.

On this subject I have to observe the following points:

(a) I was at Sulzer's as constructor from February 15, 1905, till January 31, 1908, and in that period I was exclusively entrusted with steam-turbines. Besides, I must call to your attention that at such time the construction of marine Diesel-engines was in its stage of birth.

(b) Messrs. Gio. Ansaldo & Co. became licensees of the firm Sulzer for their internal-combustion engines in August, 1915, and therefore when the Ansaldo-San Giorgio Diesel engines (then under the name "Fiat San Giorgio"), were already widely developed, as it is clearly proved by the fact that the engines for the Brazilian Submarine Dépôt-ship "Ceara"—having a power of 2,200 b.h.p. each—accomplished their acceptance trials in autumn, 1914.

In mentioned engines were already all the main characteristics of the engines fitted on the Ansaldo-San Giorgio's actual motorships and, specially, it was to be noticed the scavenging system through a series of scavenging ports controlled by piston-valve, as such system had been already adopted by the formerly "Fiat San Giorgio" since 1912.

The relationship connected later between the Ansaldo-San Giorgio, Ltd., and the Gio. Ansaldo Co., had no influence at all upon the technical constructive development of the engines built by the Ansaldo-San Giorgio in the Turin Works, which development is still independently proceeding, as in the past, and solely on the ground of own studies and experiences.

I take the opportunity to send you my regards, and remain, dear sir,

Yours very truly,
E. CHIESA,

Ansaldo-San Giorgio, Ltd.,
Turin, Italy.

[Evidently we have unintentionally done Signor Chiesa an injustice, so we gladly publish his letter. How the misunderstanding arose is clear from the above remarks. We also have seen letters from Sulzer, Frères and from the Ansaldo San Giorgio, Ltd., which endorse Signor Chiesa's remarks.—*Editor.*]

THE OPERATING-ENGINEER QUESTION

To the Editor of "Motorship,"
Sir:

As a merchant-motorship engineer let me say that America is certainly behind the various European countries in the adoption of Diesel-engines both on land and sea, we all know that and hope to see a radical change in the opposite direction.

I think that just the average motor-engineer doesn't take enough "real interest" in his work. Secondly that it is entirely too easy to get licenses as motor engineers. The examinations are as nothing compared to the examinations of those for assistant and chiefs licenses for steam. Also the experience requirements are not nearly so rigid. Most motor-engineers of my acquaintance (myself included) have paid little attention to the purely engineering part of operating Diesel-motors. There is too much tendency to scoff at rude things such as B. T. U., viscosity, degrees Baumé, indicator-cards, etc. Most of us start the engines and run them 'till something flies off or breaks down, and then strip to the waist (if we're in the tropics) and, with a good deal of profanity, start repairs.

Mind you, I don't lose sight of the fact that some fine records have been made on American ships by American engineers and some wonderful repair jobs have been done by our much maligned "gas-skinner." We're mostly a hard-working bunch of mechanics and little else, but I think that every effort should be made to get us to pay more attention to the much scoffed-at theoretical part of engineering. Also, the motor-engineer should be required to show at least as rigid an examination as the steam man before obtaining a license.

Having had some experience in steam myself I know very well that it requires a whole lot more knowledge and ingenuity to successfully operate a big Diesel plant than a steam plant of the same horsepower.

I believe that the future of the motorship depends largely upon the men that run the engines, and I have all confidence that once they realize this they will gradually become a class of efficient men who will leave nothing to be desired as to the economical and intelligent operation of Diesel power plants.

Yours very truly,
"Ship's Engineer."

C/o M. E. B. A. No. 49,
San Francisco, Cal.

FROM AN ENTHUSIAST

TO the Editor of "Motorship,"
Sir:

Your first editorial in the October issue tells me the whole story, Great Britian is building motorships. America is building more obsolete steamships to join the already obsolete fleet of the Shipping Board, now tied up at various points on the seaboard, because they are unable to compete for business.

I know you fellows on "Motorship" are good Americans and are merely marking time until you can tell the truth without going to jail for it. But I want you to know that there are others who know the truth and who will back you to the last word in telling it.

Yours very truly,
FREDERIC T. O. WOOD.

207 Union Bank Bldg.,
Chicago, Ill.

UTILIZING EXHAUST GASES FOR HEATING MOTORSHIPS

Many motorships are installed with donkey-boilers solely for the purpose of heating the accommodation of the officers and crews. In one case, namely that of the M. S. "Solitaire" of the Texas Company, it may be remembered that electrical heat was installed throughout the officers' and engineers' quarters, but the crews' accommodation was heated by ordinary domestic hard-coal furnace, attended by the crew themselves. Had a donkey-boiler been carried the law would have necessitated the carrying of three firemen to attend to this, thus involving an unwarranted cost.

MOTORSHIP has frequently urged the utilization of the exhaust-gases from the main propelling Diesel-engines for steam heating the ship. A boiler of this type has recently been drawn to our attention. We refer to the fitting made by the Bonecourt Waste Heat Boiler Co. Ltd., Parliament Mansion, Victoria Street, London, S.W. 1, England. This is a patented waste-heat boiler built in horizontal and vertical types which is claimed, raises steam very quickly solely from the exhaust-gases in addition to reducing back-pressure on the engine.

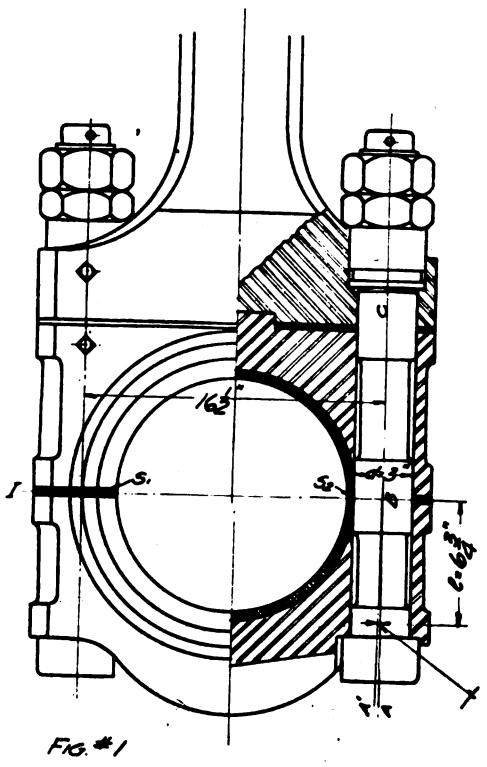
Generated on 2024-09-13 14:36 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN

Crank-Pin Boxes for Marine Engines

By R. HILDEBRAND, M. E.

THE typical crank-pin box for marine engines consists substantially of two halves, held together by two tight fitting bolts, reaching through the lower end of the connecting-rod. This design is very old, and has been adopted by all prominent marine engine builders, here as well as abroad. It has, in most cases, given splendid satisfaction. Still there are cases where the bolts have broken, and the possibility of having a bolt failure in the crank-pin boxes is a very unpleasant thought to a marine engineer, because nothing is more apt to cause a complete wrecking of the whole engine than the rupture of a crank-pin box bolt.

In the case of steam engines, it is usually not very difficult to detect beyond a doubt the cause of the bolt failure, if such does occur. But occasionally, and without apparent cause, the bolts instead of failing in the threads (which is the weakest part of the bolts), fail at the place where the two



Ordinary type crank-pin box

halves of the boxes join. This kind of crank-pin box failure occurs rather frequently in Diesel engines. The writer, for instance, knows of two such cases during the last two years, wrecking the engines. These engines were of the *stationary* four-strike type in a land installation. Investigating the case, he found that the bolts would have withstood the strains, provided the latter were caused exclusively by the inertia of the reciprocating masses, the friction and suction of the piston.

If the just mentioned forces are the only basis for calculating the needed bolt area, the bolts will be very light, they will look out of proportion to the whole crank-pin box, and they will be unsafe in practice. This way of calculating accounts for the flimsy bolts frequently seen in crank-pin boxes of Diesel engines, and it accounts for their failure. Reference may be made to "H. Gueldner, Internal Combustion Engines" who discusses broadly the failure of crank-pin box bolts. The explanation he offers (shocks due to too much play in the crank-pin box) is interesting, but it does not seem to hit the mark. Neither does the explanation—"a nut of a bolt became loosened"—hold good. In exceptional cases this may have been the cause of the accident, but in most of the cases it could be proven that the nuts were locked when the rupture occurred.

If the bolt breaks at the place where the two halves of the boxes join, the failure is not due to longitudinal forces only, but the rupture occurs as the result of an additional bending moment. This bending moment may have several causes. It may be caused by uneven shimming. Let us assume the two halves of the box to be in perfect alignment, i.e., the bolt holes to be perfectly straight. Now shims may be taken out between the two box halves, but more on one side than on the other. This will bring the two halves of the box out of alignment. Thus the bolt holes cease to be straight. The center line A-B-C changes into the line A'-B-C, causing a deflection "f" shown in Figure 1. Thus the bolts will bend when their nuts are tightened. This bending may be sufficient to cause detrimental stresses in the bolts. For instance, if the shims "S" in Figure 1 are only 0.001 of an inch thinner than the Shims "S_2," the deflection "f" of the bolt hole and of the bolt will be:

$$f = 0.001\,\frac{1}{1.65} = \frac{1}{3} \times \frac{S}{E} \times \frac{l^2}{d}$$

S equals the bending stress in pounds per square inch; E equals the modulus of elasticity of the bolt material. From this equation we find the bending stress

$$S = E \times \frac{0.001}{16.5} \times \frac{3}{2} \times \frac{d}{1} = 30{,}000{,}000 \times \frac{.003}{33} \times \frac{3}{6.75} =$$

1212 lbs. per sq. inch.

This bending stress is in reality not quite as high, as the boxes are not perfectly rigid, which is supposed in the above calculation. But nevertheless, if the shims "S" and "S_2" differ several thousandths of an inch, instead of one thousandth as figured, then considerable bending stress in the bolts may occur.

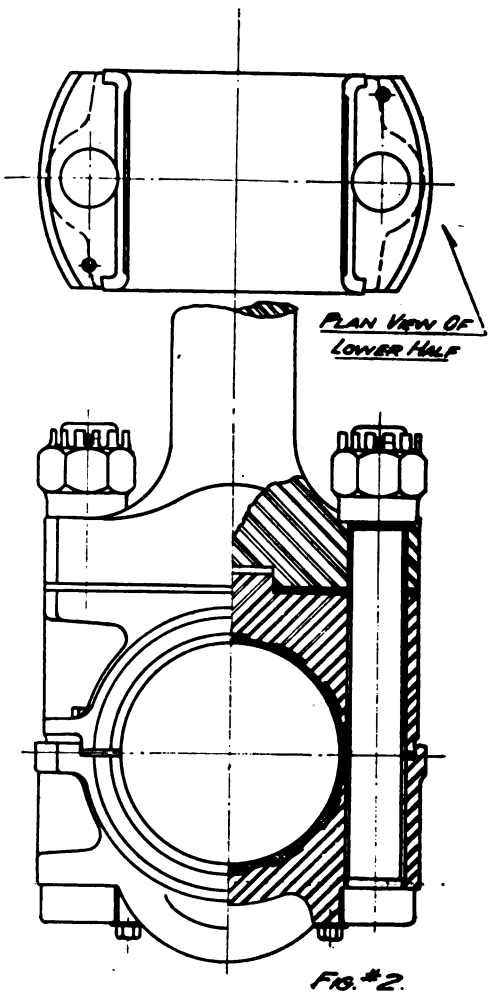
A second cause of a similar bending moment affecting the bolts may be found in the process of manufacturing the crank-pin boxes. Frequently, the two halves of the box are cast together, machined, the bolt holes reamed and then cut in two halves. Crank-pin boxes made in this way will season or warp after being cut into halves. The writer has repeatedly observed that the bore of the box after being cut into halves, comes out of the round, drawing together in the direction 1-B (see Figure 1). This seasoning or warping, which is quite considerable, will disturb the alignment of the holes in the two box halves and will cause bending stresses in the bolts. For this reason, the box should not be cast in one, but should be made in two pieces.

A third cause, effecting a similar bending moment of the bolts may be found in uneven tightening of the nuts of the bolts, and in case one of these nuts should get loose.

A fourth cause of a bending moment affecting the bolts will be detected if the lower box half, being a loaded beam, deflects unduly under its load, which will be the case if the lower box half is not sufficiently strong.

Thus we see, that bending moments affecting the bolts, causing detrimental stresses, may occur in several ways, and for this reason it is not safe if the designer bases the needed bolt area exclusively on the inertia of the reciprocating masses, the friction, and the suction of the piston, provided he uses tight fitting bolts for the crank-pin box. The peculiarity of the latter design is to blame for the said bolt ruptures.

Figure 2 represents a new box, designed by the writer, which is better, cheaper to manufacture, and easier to handle. The bolts are not fitted, but have liberal clearance, eliminating the reaming of the bolt holes and the fitting of the bolts. The box is manufactured in two pieces—as it should be—aligning each other by circular tongue and groove, as plainly shown. The shims are thus completely imbedded, and it is impossible to lose them. The nuts are castellated, having a great number of prongs, the pin having several holes, giving a sufficiently fine adjustment and positive locking of the nuts. A dowel pin and a central tongue and groove align the connecting rod and the upper half of the crank-pin box. Washers, being held by tap bolts projecting underneath the bolt heads, prevent the bolts from dropping out of the box when the nuts are removed. The heads of the bolts being round with one flat surface machined thereon, preventing the turning of the bolts. Two small tap-bolts, one on each side, hold the two halves of the boxes together, preventing them from falling into the crank case when the piston with connecting rod is to be withdrawn. The head of one of these two tap bolts can be seen in Figure 2. During actual running these two tap bolts can be dispensed with. It is obvious that the assembling of the crank-pin box inside of the crank-case and the withdrawing of the pistons is greatly facilitated, as the bolts do not need to be driven, but have liberal clearance. This is the reason why the erecting engineers who have used this style of box are pleased with its design. The appearance of the box is just as good as that of the old one; its weight is only slightly increased, provided the same sized bolts are used in both cases. As a protective measure it may be mentioned that domestic and foreign patents have been claimed for the box shown in Figure 2.



Hildebrand design of crank-pin box

BIG SWEDISH-OWNED STEAMER CONVERTED TO DIESEL DRIVE

Another large steamship has been converted to Diesel power, namely the "Augusta" owned by the Rederiaktiebolaget Banck, (Bror M. Banck) Stockhold, Sweden, who had the work carried out at Hamburg, Germany, where she has been equipped with a Swiss-built Diesel engine. As the hull was built in England in 1891, she is now somewhat of a cosmopolitan motorship. She has the following dimensions:

Present deadweight capacity.....5,000 tons
Original deadweight capacity.....4,700 tons
D.W.C. gain .....300 tons
Net cargo-capacity gain.....(about) 700 tons
Length .....330 ft.
Breadth .....42 ft. 2 in.
Mean Loaded Draught.....24 ft.
Original Engine-room staff.....13 men
Present Engine-room staff.....8 men
Original Coal Consumption, per 24 hr. day.20 tons
Present Oil Consumption, per 24 hr. day....4 tons
Daily Fuel Saving.....16 tons
Power of Main Diesel Engine.....800 shaft h.p.
Average Power on Sea Trial at 130 r.p.m.
1,128 i.h.p. (810 shaft h.p.)
Overload Power on Sea Trial at 146 r.p.m.
1410 i.h.p. (1010 shaft h.p.)
Speed of Ship (Loaded).....8 knots

The "Augusta" is a single-screw vessel and is propelled by a four-cylinder 470 mm. by 740 mm. two-cycle Sulzer Diesel-type engine developing a rated power of 800 shaft h.p. at 130 r.p.m. so the overload test of over 35% is rather noteworthy. For auxiliary purposes there is a three-cylinder Benz-Polar Diesel engine driving a 100 volt dynamo, and an oil-fired donkey-boiler working at 180 lbs. pressure. The trials were carried out during the maiden run from Hamburg to Stockholm, after but one-hour's light load running in port. For a vessel of her size the power, hence the speed, is rather low, but this may be bettered if the cast iron propeller is changed to one of bronze.

MOTOR LIGHTER FOR ANGLO-AMERICAN OIL CO.

Two 90 b.h.p. Kromhout surface-ignition oil-engines have been installed in a 220-tons lighter recently purchased by the Anglo-American Oil Company.

FIVE RIVER MOTOR-TUGS ORDERED

The N. V. Mij Binnenvaart, of Rotterdam, Holland, has ordered five river motor-tugs from the N. V. Tereenigde Scheepswerven von Gebs. van der Windt, of Vlaardingin. These crafts will be about 50 ft. long and will be propelled by oil-engines built by the N. V. Van Berkel's Patent Co. of Rotterdam.

Generated on 2024-09-13 14:34 GMT / https://hdl.handle.net/2027/mdp.39015084660904
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from UNIVERSITY OF MICHIGAN